2004

Faculty's and students' perspectives on establishing on-line collaborative community within a distance education graduate course

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Faculty's and students' perspectives on establishing on-line collaborative community within a distance education graduate course

by

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A dissertation submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Major: Education (Curriculum and Instructional Technology)

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Iowa State University

Ames, Iowa

2004

Graduate College
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Signature was redacted for privacy.

Major Professor

Signature was redacted for privacy.

For the Major Program

DEDICATION

I dedicate this work to those who dare to dream the impossible. Especially, I dedicate this to Frank who is an inspirational dreamer.

> For me, the child is a veritable image of becoming, of possibility, poised to reach towards what is not yet, towards a growing that cannot be predetermined or prescribed. I see her and I fill the space with others like her, risking, straining, wanting to find out, to ask their own questions, to experience a world that is shared.
>
> ATTRIBUTION: Dr. Maxine Greene
> Commencement address,
> Bank Street College (1987)

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ACKNOWLEDGEMENTS

My thanks go to Ann Thompson for her encouragement, high-energy, and feedback on many drafts of this dissertation. I appreciate the opportunity to have Dr. Thompson's leadership during my doctoral studies and through the process of completing this degree. I also express my gratitude for my committee's continual support and guidance; thank you, Dr. Jerry Willis, Dr. Jackie Blount, Dr. Beverly Kruempel, and Dr. Eric Abbott. Throughout my education, I have come across mentors that I have tried to model my approach to education and to life. These people have brought joy and understanding to thousands of students, which I have been one of those students. Thank you to Harry Hagedorn, my high school math teacher, for the strength to persevere. Thank you to James Handorf, my college business education advisor, for his continual presence of professionalism. Thank you to Len Froyen and P.J. Porter, my master's degree advisors, for expanding my horizons from a business perspective to an educational perspective. Thank you to Rex Thomas, one of my Iowa State University professors, for questioning and prodding me to reach my potential.

My family has provided a foundation for me to risk the impossible. Whenever I fell short of my goals, they have been there to help me pick up the pieces. I will never be able to repay for their love and support. They have quietly supported my aspirations. Every day I count my blessings beginning with each member of my family: Dad, Mom, Kirk, Eldo, Agina, Jason, Justin, and soon to be Laura.

Frank, you have been the strength behind this process. Thank you.

> Many are the conditions which must be fulfilled if the Great Society is to become a Great Community. . . The highest and most difficult kind of inquiry and a subtle, delicate, vivid, and responsive art of communication must take possession of the physical machinery of transmission, and circulation and breath life into it. When the machine age has thus perfected its machinery, it will be a means of life and not its despotic master. (Dewey, 1954/27)

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GENERAL INTRODUCTION

Distance education has subtly increased its role at universities (Miller & Husmann, 1996; Kearsley, 2000). Although it initially poses no threat to the brick and mortar institutions, some believe distance education is a disruptive technology which over time challenges established practices and transforms traditional views of teaching and learning (Archer, Garrison, & Anderson, 1999; Wilson, 2001). This disruption creates a foundation for change more than its perceived function as a delivery system (Willis, 2000). For example, distance education has reflected the brick and mortar approach of classroom teaching where faculty members use technology to transmit content knowledge to students, who are geographically separated (Moore & Kearsley, 1996).

With the emergence of each new technology, this teacher-directed approach has been tested. Currently, communication technologies (e.g., e-mail, threaded discussions, real-time conferencing, and groupware) are cheaper, faster, and more compact as compared to previous technologies. These new technologies are capable of creating dynamic and interactive learning environments (Kearsley, 2000). Hence, this disruption has led faculty to examine pedagogical strategies and to open the once isolated educational setting to technical support staff and other university staff (Kearsley, 2000; Moore & Kearsley, 1996; Willis, 2000).

The purpose of this study is to examine the conditions for change as two educational technology programs share a graduate course. The conditions in sharing this course are described by using a framework, activity theory. The

introduction is organized into two sections; rationale of study and dissertation organization. The rationale provides a basis for the case study and explains the research approach.

Rationale of Study

With the growth of communication technologies, demand for more on-line course offerings has led to increased competition among universities (Kearsley, 2000, Willis, 2000). Traditional universities have expanded distance education modules in face-to-face courses and added on-line degree programs. Private open universities have increased their marketing of lucrative alternative learning opportunities (Moore & Kearsley, 1996). Internationally, open universities, which have no physical location, have become a viable form of education. However, it has been difficult for open universities to become more established in the United States with traditional universities maintaining the majority of the market share (Wilson, 2001). One reason is the perceived higher educational quality that has been time-honored at traditional universities (Armstrong, 2000; Kearsley, 2000). For example, faculty members encourage students from other universities to take their on-line courses while strongly discouraging their students to enroll at competing universities (Willis, 2000). This competition has maintained the isolation and lack of collaboration among universities (Willis, 2000).

While traditional universities prepare for increased competition, they are also facing more challenges as they attempt to adapt to using more technology in the teaching and learning environments (Kearsley, 2000). Universities have responded

by implementing superficial changes (Moore & Kearsley, 1996; Wilson, 2001). Hence, the infrastructure has been slow to change (Fullan, Galluzzo, Morris, & Watson, 1998; Kearsley, 2000; Moore & Kearsley, 1996).

Distance education, especially at the graduate level, has been incorporated in the educational setting; however, the degree of use appears to be contingent on faculty's interests (Kearsley, 2000). For example, faculty members choose communication technologies as supplementary activities to face-to-face courses such as using electronic mail (e-mail) to communicate with students, web pages to present course information and structure, and discussion groups to continue classroom discussion. On the other hand, they use real-time conferencing to immerse learning in an on-line community or they create a unique environment by combining several technologies. Their interests diminish as administrative support and commitment also decrease, but e-mails have become an expected activity (Kearsley, 2000).

These educational settings have been viewed as being simple and predictable; however, with the inclusion of technology these settings become complex and dynamic (Nardi, 1997; Sirotnik & Associates, 2001). This complexity leads to unforeseen consequences such as matching technology's uses with pedagogy and creating individual learning within interactive environments (Armstrong, 2000). Instead of identifying uses, the effects of technology need to be examined (Rogers, 1995). These consequences or effects that are not fully understood require further research.

Consequently, this case illustrates the effects of balancing the enthusiasm of using cutting-edge technology with emerging unforeseen consequences as two geographically isolated educational technology graduate programs collaborate by sharing a graduate course. This study is constructed using a case study methodology; the following provides an overview of the research approach.

The Research Approach

Case study methodology has been chosen in order to present a rich description (Geertz, 1973) of the lived experiences (Van Manen, 1990) of the participants. My research inquiries have been guided by asking, "What are the consequences to classroom-level practices as educational technology graduate programs address educational change within a distance education setting?" Consequences of innovations have not been properly addressed in the literature (Rogers, 1995). Case study methodology provides an approach to study educational change; in particular, the process of change as more technology is being implemented (Willis, Thompson, & Sadera, 1999).

A framework to analyze this case is activity theory. This framework provides a method to examine complex educational settings by describing the interactions among the elements of an activity and by identifying emerging contradictions from those interactions (Nardi, 1997; Wilson, 2001). The elements are subject, community, object, tools, rules, and division of labor. The interactions among these elements transpire between individual and social levels that are simultaneously interwoven (Nardi, 1997). Within these settings, at least two activities are interacting

which forms an activity system (see Figure 1) (Center for Activity Theory and Developmental Work Research, 1998).

Each triangle represents, at a micro-level, an activity that simultaneously interacts with other activities. Although it appears to be a simple drawing, activity theory presents a multiple-level approach to examine complex and dynamic activities. This framework is presented in detail in the first paper and used in practice in the last two papers.

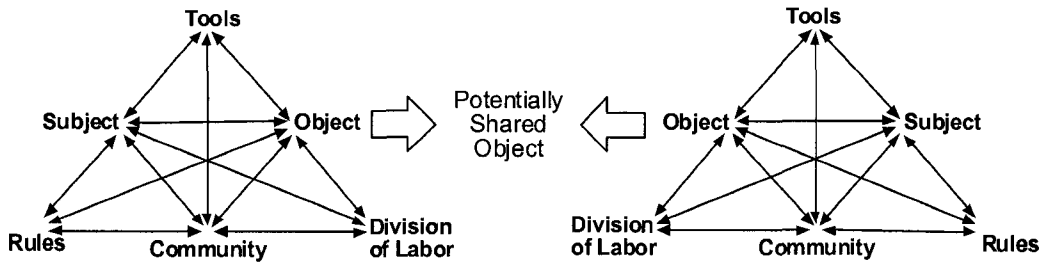

Figure 1. Activity systems.

For data collection, multiple sources are used such as transcripts from interviews, a discussion group, a focus group, meetings and presentations; course video tapes; e-mail and phone messages; field notes; and artifacts. Some of the artifacts are print and web-based materials, course readings, policy documents, and the final projects. Data collected are descriptive and provide a rich context of the interactions. Primary data sources are different for each manuscript and are described within the respective paper. The other data sources have been used to triangulate ideas, concepts, categories, and themes.

My role in this study spans several layers of responsibility. These roles are as a former policymaker, a participant researcher, a student in the course, and ISU technical support staff. These roles carry the possibilities of biases as my knowledge and experiences may obscure my view as I examine the data collected. In order to address these concerns, I have documented within each paper potential biases and methods used to limit their impact.

In addition to my role, time is also a limiting factor when data are collected and analyzed over a period of time. This study began in Fall 1998 with analysis continuing until Fall 2000. The results are specific to this case study; however, the process of identifying consequences and describing instances provides a contextual case for others in the field to relate with their experiences.

The methodology for each manuscript is explained within the respective paper with supporting evidence of methods and artifacts to be placed in the appendix. In addition to the following description of the dissertation organization, I have used activity theory as an organizing tool to demonstrate the relationship among the three papers. This illustration is located in the appendix (see Appendix A).

Dissertation Organization

The dissertation is organized according to Iowa State University's alternate format. Following the introduction, three publishable papers (manuscripts) collectively explore the consequences of sharing a graduate course between educational technology graduate programs. The three papers have been prepared

for submission to scholarly journals. Figures and tables are included in the context of each paper, and the dissertation closes with a general conclusion. References cited are listed in the respective paper and artifacts have been placed in the appendix after the general conclusion.

While the collaboration was initiated by senior faculty and program administrators, students and junior faculty experienced consequences of a technology-driven environment. This study describes students' and junior faculty members' experiences as policies and practices are challenged.

The first paper, "Technology-Driven Change in Teacher Education: A Literature Review for Theory into Practice," examines the current literature in educational change models and proposes an alternative approach. This examination provides an overview of the classical models and frameworks used by faculty to facilitate change. Theoretical meanings and cases in practice within technology-driven environments are described as they attempt to change teaching and learning practices. The lack of success of educational change as discussed in the literature provides a foundation for proposing an alternative approach. This approach, activity theory, is constructed on the complex characteristics of the whole educational setting and emergence of unforeseen consequences. The application of activity theory within a distance education setting is demonstrated in the second and third papers.

Junior faculty members' perspectives are presented in the second paper, "Making Choices in Distance Education: Rediscovering Pedagogy in a Technology-Driven Environment." These perspectives include the difficulties of learning how to

teach by using technology in a distance education course. Although faculty members may have a supporting community, such as technical staff, the focus tends to be geared toward technology rather than instruction. Hence, within a technology-driven environment, pedagogy appears to get lost in the shuffle. For this paper, the significance is the lessons learned as faculty members explore how to harness the power of technology and how to pedagogically create a learning space. They also discuss learning to use technology while interacting with technical support staff on balancing technical capabilities with pedagogical understanding. The story provides faculty and technical support staff insight on discovering how technology supports pedagogy within distance education settings.

The third paper, "Constructing an On-line Collaborative Community: Listening to Students' Voices," describes students' experiences during the shared graduate course between educational technology programs. The focus is on the formulation of an on-line collaborative community from students' perspectives. Students' voices are often silent in the design of instruction; therefore, this paper provides valuable information to help designers in the creation of student-centered on-line learning communities. While the second paper examines changes in teaching practices, this paper discusses changes in learning practices. Students explain their experiences while they strive to achieve course objectives.

Overall the strength of this dissertation lies in the contribution of each individual paper as well as the collective contribution of all three. The first paper presents the educational change literature review. This paper also proposes an alternative approach to using change models. This method, activity theory, examines

the whole setting versus isolating certain elements. Activity theory is used in the last two papers to describe the setting from two different perspectives. The second paper discusses balancing pedagogy and technology within distance education settings from faculty's perspectives. Finally, the third paper presents students' perspectives as they experience learning within a technology-driven environment. The qualitative methods used in the last two papers result in a rich comprehensive source of primary data. The papers provide a vision of how faculty members recognize and examine consequences of using technology within an educational setting and sustain change with this knowledge.

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TECHNOLOGY-DRIVEN CHANGE IN TEACHER EDUCATION: A LITERATURE REVIEW FOR THEORY INTO PRACTICE

A paper to be submitted to the *Journal of Teacher Education*

Rhea R. Walker

Introduction

Teacher education has been recognized by policy circles to have an essential role in education reform (Goodlad, 1999). With this recognition, policy at both state and national levels has been legislated to reform teacher education by offering monetary and equipment incentives (Fullan, Galluzzo, Morris, & Watson, 1998; Goodlad, 1999; Pacheco, 2000). In the USA, these incentives have been used to address change in teaching and learning practices by increasing technology use in pre-service programs (Cuban, 2001). For example, distance education programs have been implemented in teacher education to increase access for students and to alleviate travel by faculty (Armstrong, 2000). However, even with increased technology use, teacher education has not changed dramatically (Fullan, 2001; Goodlad, 1999; Guthrie, 1999).

The purpose of this paper is to review educational change literature in theory and practice by examining the transformation of teacher education at particularly the graduate level within technology-driven environments such as distance education.

Cases in practice are provided that describe distance education activities within educational technology graduate courses. After reviewing the literature and providing cases, I propose activity theory as an alternative approach to using some educational change models. Contrary to these models that isolate components, activity theory is used as a descriptive tool to examine the whole educational setting (Wilson, 2001b). By using activity theory, contradictions or consequences are identified. By examining the whole setting and identifying unplanned consequences, faculty members have a better understanding of change within a complex educational setting.

This paper is organized beginning with defining educational change followed by describing technology's functions in distance education settings. Next, commonly used educational change models are presented within a unique framework provided by Ellsworth's book, "Surviving Change" (2001). Along with this framework, cases in practice are used to illustrate contextual examples of how change models have been applied in teacher education. After a discussion of Ellsworth's framework, I propose activity theory as an approach to describe the setting. First, educational change needs to be defined.

Definition of Educational Change

By examining educational change literature, there appears to be no definitive definition. Lack of an agreed upon definition is reflected in the philosophical separation between groups of education scholars as each attempts to initiate change (Conley, 1993; Gonzales & Roblyer, 1996). One group defines educational

change as a product where an innovation is implemented to modify an existing practice to enhance its efficiency (Conley, 1993; Fullan, 2001). This definition reflects early views of educational change, which are rooted in objectivity and scientific management (Evans, 1996). Here, change is disseminated from the top down and is considered to be predictable and linear (Evans, 1996; Hargreaves, 1997). For example, technology improves instruction by efficiently presenting and assessing content through computer assisted instruction. However, in the literature, there are numerous examples of failed change attempts based on this product view of change (Evans, 1996; Hargreaves, 1997; Sarason, 1990). Therefore, educational change needs to be furthered clarified.

Another group of scholars defines educational change as a social process where meaning about content and theory of educational practice are shared and negotiated according to existing knowledge and beliefs (Fullan, 2001; Oaks, Wells, Yonezawa, & Ray, 1997). This definition is more subjective with a foundation in a systemic approach (Gonzales & Roblyer, 1996). The difficulty in finding meaning within this subjectivity is attempting to understand what to change and how to change it. There appears to be a struggle between current practice and conditions for new practice that persists under a cloud of uncertainty (Fullan, 2001; Gonzales & Roblyer, 1996).

Although change has been identified, there exists the constant interaction between what and how that leads to reshaping the context (Fullan, 2001). Hence, uncertainty is perpetuated as the context is continually changing (Conley, 1993; Fullan, 2001; Gonzales & Roblyer, 1996). For example, technology provides

information for project-based learning and supports communication in a collaborative learning environment. Although technology is a component of the setting, the focus is on interactions among faculty in the change process.

In summary, defining educational change has been stratified according to groups of education scholars that are attempting to change education. One group sees change as a product, which follows an objective method while the other group perceives change as a process, which is more of a systemic view. These attempts have ranged from teacher-proofing education to empowering teachers with site-based management (Gonzales & Roblyer, 1996). Thus, change has been described as a product or a process depending upon the selected definition as discussed previously. For this study, educational change is viewed as a process.

Educational change is further complicated with growing demands for technology use in face-to-face classrooms as well as virtual environments. Within distance education, technology has traditionally been used as a delivery method of inertly transmitting teaching and learning. This method reflects the efficiency of the objective definition (Kearsley, 2000; Roblyer & Bennett, 2001). However, technology plays additional functions from a systemic perspective. These functions are described in the next section.

Technology as Mediator of Change

Policymakers view technology as a catalyst to change education (Davis, 2000). For example, in the USA, a competitive grant initiative, Preparing Tomorrow's Teachers to Use Technology (PT3) from the U.S. Department of Education awarded

universities several million dollars since 1999 to transform teacher education (Carroll, 2000). Some programs have used these monetary and equipment incentives to initiate distance education activities as a vehicle to change traditional practices (Marra & Jonassen, 2001; Willis, 2000). However, distance education has initiated a slow unyielding disruption to policy and practices of brick and mortar institutions such as balancing collaboration and competition with other programs (Archer, Garrison, & Anderson, 1999; Armstrong, 2000; Moore & Kearsley, 1996).

For example, communication technologies have enabled programs to enhance their collaborative efforts from sharing timely information with colleagues to forming joint research and policy consortia (Darling-Hammond 1997; Kearsley, 2000; Wilson, Sherry, Dobrovolny, Batty, & Ryder, 2000). These technologies have also helped private open universities to expand their student market. This growth has increased competition for student enrollment between public and private open universities (Armstrong, 2000; Willis, 2000).

In this competitive market, teacher education programs have maintained their value based on national accreditation of their programs and credentialing of pre-service teachers. However, a historical measure for accreditation and credentialing has been seat time, where students earn their degree by accumulating the prescribed number of courses with appropriate grades (Fullan, 2001; Fullan, et al., 1998; Pacheco, 2000; Wilson, 2001b). Another alternative measure for learning is to use competencies. These competencies are preferred in virtual environments over using virtual seat time (Wilson, 2001b).

Economic pressures, technological innovations, and competition for student enrollment have influenced changes as programs try to enhance their marketability and value (Cuban, 2001; Pacheco, 2000). Initially, changes in practice are planned; however, policy has been subtly challenged as teacher education programs experience growth in on-line course offerings (Armstrong, 2000; Fullan, 2001; Willis, 2000). Hence, programs appear to use technology to support change in practice while technology attempts to change programs and its policies. Although distance education has been used previously, the degree of these changes varies according to faculty's intentions to accept, modify, or reject these external influences (Dede, 1996).

While programs increase use of distance education, at a classroom level, faculty members are implementing a variety of distance education formats (Dede,1996). These formats range from face-to-face courses with minimal support from communication technologies (e.g., e-mail, threaded discussions, real-time conferencing, and groupware) to full immersion in on-line distance learning environments (Armstrong, 2000; Kearsley, 2000). Within these formats, faculty members have traditionally used technology to deliver instruction, explore information on the Internet, and increase teaching and learning efficiency (Jonassen, Peck, & Wilson, 1999; Means, 1994). By transmitting their instruction, they attempt to neutralize technology to enhance a direct connection to their students (Nardi, 1997; Wilson, 2001b).

With rapid technological changes, faculty members find it difficult to choose, let alone, understand how technology supports learning (Marra & Jonassen, 2001).

This leads faculty to resort to using the same passive lectures found in face-to-face classrooms for their on-line courses (Kearsley, 1998; Palloff & Pratt, 1999). However, with communication technologies, some faculty members have used computer conferencing to communicate with student teachers. They have altered their reliance on transmission pedagogy by incorporating another, learner-centered pedagogy (Palloff & Pratt, 1999). This change mirrors the shift from teacher-directed instruction to student-centered learning (Marra & Jonassen, 2001; Wilson, 2001b).

Student-centered learning is faculty and students collaboratively constructing knowledge by sharing multiple perspectives and using more authentic assessment (Bransford, Lin, & Schwartz, 2000; Jonassen, et al., 1999). Instead of technology functioning as an instructional tool, it functions as a learning tool within a setting that looks and feels different (Jonassen, et al., 1999; Papert, 1993).

Within this setting, students choose to enroll in on-line courses to have better access to experts and courses not conveniently available to them (Moore & Kearsley, 1996). However, students become frustrated with these courses and decide to drop out (Kearsley, 2000). These frustrations surface as students find themselves struggling with their lack of technical skills, underestimating their time management abilities, misunderstanding expected social communication, and feeling isolated from faculty and other learners (Hara, 2000; Miltiadou & McIsacc, 2000; Navarro, 2000). The high attrition rate among on-line learners is a consequence of using transmission pedagogy where attention is given to sharing individual experiences rather than creating group experiences (Hara, 2000; Marra &

Jonassen, 2001; Schrage, 1995). An alternative to transmitting knowledge to individual students is to develop a community of learners (Hemming, 1999).

A community of learners is learners achieving a shared goal by socially interacting and collaborating where there exists a sense of interdependence within a supportive infrastructure (Hung & Chen, 2001; Palloff & Pratt, 1999; Wilson, 2001a). Infrastructure aids in the formation of communities and includes code of conduct, diversity of expertise, division of responsibilities and roles, and methods of settling disputes (Hung & Chen, 2001; Palloff & Pratt, 1999). Some indications of a growing community are active interaction, collaborative learning, socially constructed meaning, sharing of resources, and expressions of support (Palloff & Pratt, 1999).

Within an on-line community, technology is flexible in how it functions (see Table 1). This flexibility varies according to the level of the community's development, faculty's pedagogical choices, and the program's expectations. In the following table, these functions have been categorized according to pedagogical intent of either transmission or learning. After the table, each function is described with the transmission functions presented first followed by the learning functions.

Table 1. Technology's functions.

Pedagogy	Kuutti, 1997	Jonassen, et al., 1999	Means, 1994	Taylor, 1980
Transmission	Automate Human Operation	Deliver Instruction	Tutor	Tutor
	Inform	Information Vehicles	Explore	Tutee
Learning	Tool	Productivity Tools	Applied Tools	Tools
	Communicate	Social Medium	Communicate	
	Mediate	Intellectual Partner		

Technology functions as a method of delivering instruction where it tutors or teaches the lessons (Jonassen, et al., 1999; Means, 1994; Taylor, 1980). By delivering instruction, operations or routines during this process become more efficient as technology automates human operations (Kuutti, 1997). An example of this function is using instructional television to teach students how to use Microsoft PowerPoint.

Another function, tutee, describes students teaching computers to perform a particular task. Students using simulations illustrate this function (Taylor, 1980). Similar to tutee, technology also provides students with information to assist in students programming. The Internet is an example of the information vehicle function (Jonassen, et al., 1999; Means, 1994; Taylor, 1980). While the above functions are more instructional, the following discusses technology's functions from a learning perspective.

The tool function provides a general capability where students construct knowledge (Jonassen, et al., 1999; Means, 1994; Taylor, 1980). Some tools are graphical while others are textual such as word processing tools (Jonassen, et al., 1999; Means, 1994; Taylor, 1980). Technology also functions as a means of communicating or conversing such as corresponding through e-mail or using discussion postings (Jonassen, et al., 1999; Means, 1994; Taylor, 1980).

The last function as shown in Table 1 is intellectual partner (Jonassen, et al., 1999; Kuutti, 1997). Intellectual partner is the function of technology to support learning by reflecting and representing what students know (Jonassen, et al., 1999). Cognitive tools are examples of this function. In activity theory, this function is similar to mediation. Mediation makes it possible for a student to achieve the object of the

activity (Kuutti, 1997). In this sense, technology moves beyond delivery and communication functions to another level of creating the possibility of an activity or enabling an object in the activity. For example, real-time conferencing makes it possible for universities to share a course and for students to achieve learning. However, this mediation function has additional attributes that are not present in the intellectual partner function.

Technology's mediation function also brings to the activity historical and cultural context. This context empowers as well as limits (Kaptelinin, 1997). It empowers with the ability to transform the process of achieving learning (object), but it also restricts the interaction from the perspective of that particular tool (Kaptelinin, 1997). For example, the Internet, the backbone of communication technologies, is described as a democratic instructional tool for universal sharing and access (Lessig, 2001). However, the Internet reflects values and ideas that affect the surrounding social conditions and operations of power (Bowers, 1988; Bromley, 1998; Wilson, 2001b). This democratic empowering tool provides more barriers than once believed. These barriers include control of content, lack of access, and lack of cultural fit (Lessig, 2001; Ryder, 1995; Wilson, 2001b). While using the Internet, a real-time conferencing tool brings cultural knowledge, values, and goals such as physical appearance, learning styles, and social expectations (Engeström & Escalante, 1997). Students viewing their physical presence limit their interactions as the video tool obscures their perceptions.

In summary, while technology has become smaller and less expensive, demand has increased for more on-line courses (Kearsley, 1996; Wilson, 2001b).

Technology has also become more flexible in the educational setting; in particular, communication technologies have enabled a different learning environment that moves beyond transmitting knowledge. With increased use of communication technologies, faculty and students have the opportunity to create in real time a pedagogically sound environment conducive for active learning, knowledge construction, and discursive interactivity (Collis, 1997; Geer, 2000). However, the mere existence of technology does not justify the instructional need to use it (Powers & Dutt-Doner, 1998).

With the inclusion of technology in the change process, faculty members find technology difficult to know how to use it within the constructs of teacher education's complex environment. Hence, in a distance education setting, faculty members view technology as a function to transmit their knowledge to their students or possibly to communicate within learner-centered environments (Cuban, 2001; Palloff & Pratt, 1999). Consequently, students are experiencing on-line learning within this dynamic environment as programs are faced with changes to policy. Faculty members are also attempting to change their practice while technology challenges programs' policies and faculty members' practices (Marra & Jonessen, 2001; Willis, 2000).

Within this dynamic environment, faculty members have implemented classical change models to guide them through the change process; however, the literature has not shown a high success rate (Goodlad, 1999; Hargreaves & Fullan, 1998; Wetzel, 1998). Some believe these change models, which are imported from other fields such as business and engineering, are not based on educational values (Sarason, 1990; Sirotnik, 2001). Therefore, a timely review of educational change

literature applied within the unique context of teacher education is required to understand change in this setting.

An Overarching Model for Educational Change

Ellsworth (2001), in his book "Surviving Change," presents a literature review of change models most commonly used in education. He proposes that individual models have not addressed the systemic change necessary to sustain change. From his review, he suggests a combined approach of planned change by organizing these change models in a specialized instance of the general communication model. This specialized model is illustrated in Figure 1 (Ellsworth, 2001, p. 32).

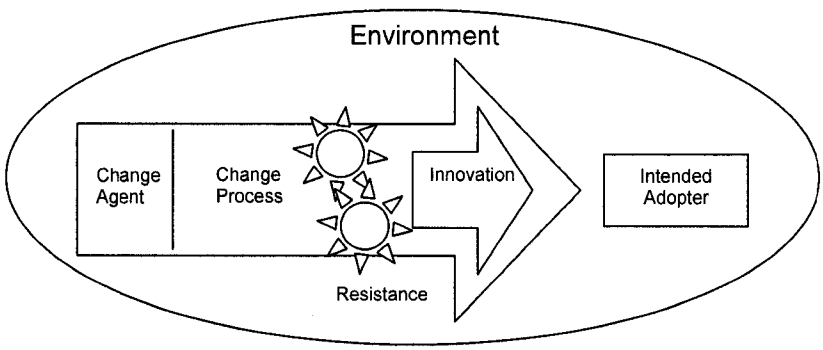

Figure 1. Change communication model.

In this change model (Ellsworth, 2001),

> We have a *change agent* who wishes to communicate an *innovation* to an *intended adopter*. This is accomplished using a *change process* that establishes a channel through the *change environment* between two

> communicants. However, this environment also contains *resistance* that can disrupt the change process or distort how the innovation appears to the intended adopter (p. 26).

These six components, shown in both the above figure and paragraph, individually represent separate models. However, by integrating the six components, Ellsworth (2001) describes the change communication model as a whole system. Faculty members are able to manage change by choosing the appropriate tool from this model (Ellsworth, 2001). The whole system provides an approach or strategy to combine the strengths of each model within a systemic context (Ellsworth, 2001).

The following discussion addresses each component of the change communication model in the order Ellsworth presents them in the above description. Table 2 lists the model's components with the appropriate supporting literature. Cases in practice have also been retrieved from the conference proceedings of Society for Information Technology and Teacher Education (SITE) as examples of particular components in the model. SITE is an international organization of teacher educators and affiliated associations that are interested in creating a knowledge base in information technology and teacher education (SITE, 1998).

Table 2. Components and supporting literature.

Components	Model or Framework	Literature
Change Agent	Change Agent	Fullan, 1991
Innovation	Diffusion of Innovation	Rogers, 1995
Intended Adopter	Concerns-Based Adoption	Hall & Associates, 1987
Change Process	CREATER	Havelock & Zlotolow, 1995
Environment	Conditions	Ely, 1990
Resistance	Barriers	Zaltman & Duncan,1977

The cases have been chosen based on the following criteria: distance education format is being implemented to some degree; and technology, in particular communication technologies, is used as a catalyst for change. Although the systems approach is not a component of the change communication model, the concept is represented in Ellsworth's model as a whole approach of the change agent communicating the innovation to an intended adopter. Therefore, this section closes with an overview of systems approach.

Change agent

Change agents, according to Fullan and Stiegelbauer, are stakeholders such as teachers, principals, students, district administrators, consultants, parents, and community members (1991). Because this model tends to be used in K-12 applications, government officials and teacher educators are considered external stakeholders (Fullan, 2001). By using this model, the focus is on the characteristics and limitations of each stakeholder, who in this case is implementing technology. In-service teachers, for example, hinder or increase the likelihood of using an innovation based on their belief of how the innovation helps them in the classroom. Although each stakeholder acts in isolation of each other, the expectation is to build coalitions with other change agents (Fullan, 2001). These coalitions amplify the potential of true, meaningful change (Fullan, 2001).

In a case example, Temple University teacher educators instigated comprehensive changes in their technology planning. The first step was developing collaboration among several stakeholders by creating the Teaching-Learning

Technology Roundtable (TLTR) (Snelbecker, Slesaransky-Poe, Slesaransky, Fitt, Miller, Schifter, Smarkola, & Teitelbaum, 2001). These stakeholders, although predominantly at the university level, included teacher educators, administrators, students, community members, and K-12 staff. By listening to the stakeholders' views regarding benefits and concerns, TLTR was able to produce an effective technology plan. Part of this plan was to create an on-line master's degree in education for local teachers. The process of creating this degree included asking teachers what skills and corresponding courses were needed for them to become better prepared to teach with technology. Several distance education formats from hybrid courses to full immersion in on-line learning were implemented.

As a result, the TLTR team discovered unexpected barriers for the learners, which included their limited learning styles, lack of equipment, and limited computer skills (Snelbecker, et. al., 2001). Although TLTR team experienced barriers, their initial approach changed from emphasizing technology driving curriculum and instruction to a better approach of curriculum and instruction driving technology (Snelbecker, et al., 2001). In summary, TLTR, change agent, focused on creating a collaborative environment for teachers, intended adopters, to best use technology as a tool for learning and teaching. One use of technology was to deliver an on-line master's degree, which resulted in unforeseen barriers.

Innovation

The second component is innovation. According to Rogers (1995), diffusion of an innovation is based on what the perceived innovation attributes are and how they

affect the adoption rate. The variance in users' willingness to adopt an innovation comes from relative advantage, compatibility, complexity, trialability, and observability (Rogers, 1995). Rogers provides an example of e-mail. Relative advantage for e-mail was not at first realized, because the first adopter had no one to communicate with. Therefore, the advantage was not reached until there was a critical mass of adopters (Rogers, 1995).

In a case example, the education department at George Fox University initially adopted an on-line system that was dependent upon a "rigid, centralized technology structure" (Headley & Carr, 2000, p. 647). This system was not adopted by faculty based on its incompatibility to address and support teaching and learning needs of the environment. Instead, the system focused on the abilities of the technology (Headley & Carr, 2000). As a result, this on-line system failed.

An alternative system was developed by faculty to address specifically the needs of adult learners. Contrary to a previous technology-focused system, this alternative system was designed from the grassroots, which began with faculty members finding a system compatible with their educational values. The complexity of the innovation emerged as traditional teaching and learning practices were often in conflict with web-based learning. To address these concerns, faculty created flexible course templates that enabled others to safely try innovative approaches within this new system (trialability).

As a result of this sharing, faculty members were able to observe the educational value and advantage of teaching and learning in a virtual environment. By using a grassroots approach to create an on-line system, a better action plan

provided an enhanced probability of the innovation being adopted by faculty. In summary, the adoption of an on-line system was dependent upon how adopters of the innovation viewed its advantage as compared to current methods. This adoption challenged faculty members' educational values and traditional teaching and learning practices.

Intended adopter

The third component, intended adopter, is the focus of Hall and Associates' Concerns-Based Adoption Model (CBAM). The intention of this model is for the change facilitator to understand how the intended adopter perceives change (Hall & Hord, 1987). In order to accomplish this, the change facilitator chooses strategies based on data obtained from three diagnostic tools: stages of concern, levels of use, and innovation configuration. According to Hall and Hord (1987), these tools have been validated through extensive CBAM research. The ensuing data from the tools are collected over a period of time. From this collection, change facilitators determine trends (Hall & Hord, 1987).

Although the goal is to move an intended adopter through the levels of concerns, Hall and Hord caution that the movement cannot be forced (1987). This model is used to track and assess progress of the individual in order to determine the appropriate method of movement (Ellsworth, 2001; Hall & Hord, 1987). The one caveat of this model is the change facilitator has to be trained to interpret diagnostic tools and to select the appropriate intervention.

In a case example, Adams, Dunham, Wells, and Shambaugh described their approach of preparing educators to integrate technology in their teaching and learning (2001). This approach followed Goodlad's (1999) simultaneous renewal of K-12 schools and teacher education programs. A partnership was developed and called Tek 21 Model of Teacher Preparation and Professional Development. Through this partnership, goals were to provide pre-service teachers experiences in using technology and to support this changed learning environment. One method used to accomplish this included Professional Development School Institutes (PDSI). These institutes enabled teachers to create web-based materials including use of chat rooms, web pages, web boards, and other communication technologies.

In-service teachers preferred teacher-directed instruction, lacked computer skills, and did not integrate technology in their teaching. To address these issues, change facilitators used CBAM tools, such as stages of concerns, to track teachers as they adopted or implemented a new practice.

The initial findings indicated the PDSI were effective in addressing internal concerns of the teachers such as improvement in skill level and comfort level (Adams, et al., 2001). From these findings, faculty members renewed the process of preparing pre-service teachers (Adams, et al., 2001). In summary, the change facilitators used CBAM's diagnostic tools to monitor the teachers' progress of using technology in the classroom. By tracking teachers, information was used to support changes in the teacher education program (Adams, et al., 2001).

Change process

The fourth component is the change process. This component, according to the change communication model, is the "channel by which the innovation is conveyed to its intended users" (Ellsworth, 2001, p. 112). Havelock and Zlotolow's C-R-E-A-T-E-R model illustrates this channel by examining the phases of planned change that are illustrated in a circular layout. These phases are care, relate, examine, acquire, try, extend, and renew (Havelock & Zlotolow, 1995). Although it appears to be linear, the model is viewed as a series of cycles where the change agent studies the phases within each rotation with emphasis placed on the interrelations among the phases (Havelock & Zlotolow, 1995). This model appears to be similar to Concerns-Based Adoption Model (CBAM); however, the CREATER model looks at the whole system while CBAM focuses on an individual adopter (Ellsworth, 2001).

In a case example, at the University of Florida, the College of Education initiated systemic change by infusing technology in their teacher education program. The CREATER model was chosen to guide those changes. Project directors believed this model to be flexible in moving forward and backward within a dynamic process. They viewed not only the technology but also the interrelationships among the different phases. For instance, there appeared to be a continual intersection between care and relate phases, which either supported or hindered change (Swain, Foti, & Dawson, 2001). To address this intersection, an on-line technology support center was implemented. This center offered support to university students, in-service teachers, and local school children. It also created a supporting mechanism

that initiated as well as maintained change in how users approached technology (Swain, et al., 2001). In summary, project directors used this model to monitor planned change of infusing technology by examining the phases and resulting overlap between these phases.

Environment

The fifth component, environment, recognizes that other factors influence adoption. Ely has identified eight conditions (1990). These eight conditions affecting change across several cultural settings are (1) dissatisfaction with the status quo, (2) sufficient knowledge and skills, (3) available resources, (4) time, (5) rewards or incentives, (6) participation, (7) commitment, and (8) leadership. Furthermore, according to Ellsworth, Ely has updated this framework to be reflective of emerging educational technologies (2001). Within the change communication model, this component represents the context, which the other components operate within (Ellsworth, 2001). This framework differs from a systemic approach by examining at the micro-level a particular change event (Ellsworth, 2001).

In a case example, at Florida Gulf Coast University, the goal was to transform teaching practices and technology use within distance education by removing aversive conditions (Bohannon, 2001). A faculty support system was established to support this overall goal. This system identified factors that were necessary to obtain classroom equipment, to acquire specialized skills by the faculty, to induct new faculty quickly in learning digital tools, to address limited time and inflexible schedules, and to understand different learning styles (Bohannon, 2001).

By creating this support system, the university enabled faculty to receive necessary training as part of their orientation sessions. After several years of implementation, the changes resulted in 89% of the students surveyed believing the technology enhanced environment was conducive to learning and 71% agreed that distance education was a viable alternative to traditional classrooms (Bohmann, 2001). In summary, by identifying aversive conditions from an individual's perspective, the university was able to isolate these conditions to better concentrate on successfully meeting their goal of changing practice in distance education.

Resistance

The sixth component, resistance, is detailed in Zaltman and Duncan's "Strategies for Planned Change." Resistance, in the change communication model, is the static, noise, or interference that comes from inside or outside the client system (Zaltman and Duncan, 1977). The perceived barriers originate from the change agent or the client. The 18 barriers are grouped into four major categories: (1) cultural, (2) social, (3) organizational, and (4) psychological. Along with these categories, Zaltman and Duncan offer guidelines to minimize or address reasons for resistance and present a diagnostic tool to identify resistance and to design interventions (1977). Although resistance results in constructive feedback, change agents often ignore it or deal with other issues and the multitudes of triggers that contribute to it (Ellsworth, 2001).

In a case example, computer-mediated communication (CMC) had eroded the traditional relationship between Chinese students and teachers (Tu, 1999). The

teachers felt their authority had been threatened by the lack of social context cues often used in face-to-face classrooms. In the Chinese culture, the expected student behavior was to be quiet and have respect for authority (Tu, 1999). By using CMC as part of their courses, teachers unexpectedly encountered on-line flaming, which was uninhibited behavior. This behavior was interpreted as antisocial (Tu, 1999). Therefore, this technology had threatened teachers' authority by not observing traditional accepted practices (Tu, 1999).

Prior to on-line flaming, students expressed their opinions as long as it was done in a respectful manner. After experiencing flaming, the solution was to address faculty's resistance to CMC use by examining Chinese teachers' roles and encouraging students to express their opinions. However, teachers and students needed to discuss and agree on rules of conduct and appropriate ethical behavior prior to implementing CMC (Tu, 1999). In summary, faculty and students were able to address the emerging resistance to CMC by identifying the interpretation of on-line flaming from a cultural perspective.

Systems

Systems approach is the whole context surrounding change including subsystems and their interrelationships (Ellsworth, 2001). However, as noted previously, systems component is not an identified part in Ellsworth's model. Systemic change paradigm is described as "complex, nested interdependencies among system components that allow the system to function as more than the sum of its parts, or leave it unable to function at all" (Ellsworth, 2001, p. 212). In other

words, this change agent understands the bigger picture while working on individual puzzle pieces. Common aspects for systems change are (1) ensuring stakeholder involvement, (2) challenging old assumptions, (3) planning for ripple effects, and (4) creating a viable system (Ellsworth, 2001).

In a case example, Polman, Mastin, Beyer, and Navarro (2001) proposed lasting change by having components of an educational system support one another. They envisioned transforming the whole system by providing "a whole new scene where university instructors and students preparing to be teachers try out new ways of acting" (Polman, et al., 2001, p. 2062). While their goal was to change current practice of teaching and learning, change agents worked on individual puzzle pieces. These pieces, from policy to faculty teaching practices, were to support integration of technology into teaching and learning (Polman, et al., 2001).

Faculty and students began by creating resource web pages that included information and additional links to related sites (Polman, et al., 2001). Students reported they initially felt overwhelmed and stressed; however, scaffolding activities provided by faculty helped them feel more comfortable. Their other frustrations included lack of additional support staff and access to computers outside of the course (Polman, et al., 2001). In summary, while the overall task was to change practice, the method of achieving this goal was to work on individual pieces such as teaching web development.

Summary

Teacher educators have chosen to use many change models to guide them through the planned change process when introducing innovation such as distance education. However, there has not been substantial change (Fullan, 2001; Guthrie, 1999; Goodlad, 1999). Ellsworth believes successful planned change is enhanced by combining select models in a collective approach called change communication model (2001). The above discussion provides an overview of each model and cases in practice of implementing distance education activities within teacher education settings. However, this does not adequately address formulating change in the complex setting of teacher education.

For example, Ellsworth describes this model as a method of achieving planned change. However, each component of the model concentrates on one element, which is often the individual or from an individual's perspective. Technology's function in the change process is also viewed by the individual to be secondary to the actual process. Technology is used as a tool to manipulate and to enhance the achievement of an expected result. These areas of planned change and technology's function create uncertainty of how effective the change communication model is in guiding change in, particularly, teacher education. Although the system approach has merit, it has not been presented by Ellsworth as part of this model.

In the following section, I offer suggestions to approach change differently than the change communication model to increase possibly sustainable change. These suggestions focus on the following questions: (1) Does planned change

address the whole educational setting adequately when change is attempted within a chaotic technology-driven environment? (2) What are the consequences of downplaying technology's function within an educational setting?

Discussion

The most common frameworks and models for looking at change are discussed in Ellsworth's "Surviving Change" (2001). Ellsworth (2001) presents change theory from several camps based on research and practice and suggests bringing "the models together in a toolbox" as an overall strategy to guide change (p. xvi). This approach is derived from Rogers' (1995) discussion of diffusion being a "special type" of the general communication model where ideas are communicated in a social system (p. 5).

Ellsworth (2001) places diverse models in the communication model and identifies it as the "change communication model" (p. 32). Although Ellsworth follows planned change discussed in Rogers' "Diffusion of Innovation," Rogers (1995) does not restrict change to being planned. Change is also the "spontaneous spread of new ideas" (Rogers, 1995, p. 7). Moreover, planned intentions have little influence on spontaneous ideas or unintended consequences in complex environments such as teacher education (Jonassen & Roherer-Murphy, 1999; Wilson, 2001b). Therefore, Ellsworth's model is flawed with this restriction. So, the following section addresses the first question on planned change: Does planned change address the whole educational setting adequately when change is attempted within a chaotic technology-driven environment?

Planned change

Strategies and planned tactics are often used in education to promote change, which is in response to demands for change and does not address the actual process (Jonassen & Roherer-Murphy, 1999; Wilson, 2001b). Although a strategy is effective, in practice, human behavior in a changing environment is more reflective of chaotic and complex activities (Wilson, 2001b). For example, with increased use of communication technologies, some teacher education programs have initiated sharing best practices and resources and creating partnerships with other programs as a result of PT3 funding (Carroll, 2000; Fullan, et al., 1998; Pacheco, 2000; Goodlad, 1994).

By using these technologies, faculty members take the opportunity to "explain their accomplishments [rather] than to learn from the work of others" (Sirotnik, 2001, p. 200). This is a predominant model of academic inquiry expected at universities that are traditionally practiced in the academic structure (Elmore, 1996; Miller & Stayton; 1999; Mitchell, 1999). Change appears to be occurring while the status quo remains intact; therefore, in this example, the initial intent of creating partnerships is not realized. Some believe, however, collaborative partnerships are imperative in educational change (Elmore, 1995; Fullan, et al., 1998; Hargreaves & Fullan, 1998).

Planned change has not been successful when single unrelated changes in curriculum and instruction are attempted (Fullan, 2001). The intent is to make changes to one isolated component such as an individual or an innovation within a dynamic system. This component once let go to maintain its altered position is over time pulled back into its previous alignment with the other components (Tyack &

Cuban, 1995). Hence, change is not sustained. This process of isolating the dynamic system into parts strips the understanding of the whole system and the complex interrelatedness of all its parts. The disconnected parts emerge where the whole is no longer complete (Flood, 1999).

Instead of concentrating on planned change as disconnected parts, change is considered a process of balancing between stability and instability or a state of chaos within a dynamic interrelated system (Flood, 1999; Stacey, 1996). In other words, within this state of chaos, the whole is made up of many interrelated parts where neither the parts nor the whole are examined in isolation. This process is constantly shifting with "endless occurrences of spontaneous self-organisation" (Flood, 1999, p. 2). Although spontaneity is difficult to predict or control, it reflects the dynamic and complex nature of what is happening at this point in time within a social activity (Flood, 1999; Nardi & Day 1999). This interrelatedness is also an "ever-expanding activity," which acts as a domino or ripple effect in the setting (Flood, 1999, p. 91).

In a technology-driven environment, long-term planning is further complicated by the rapid pace of ever-changing technology, especially digital technology (Dertouzos, 1997; Nardi & Day 1999). Digital technologies such as computers and communication technologies have created opportunities to transform traditional learning practices in brick and mortar classrooms into, at times, chaotic nonlinear learning in virtual environments (Jonassen & Roherer-Murphy, 1999; Moore & Kearsley, 2000; Tyack & Cuban, 1995; Wilson & et al., 2000). As the environment becomes chaotic and possibly unpredictable, faculty members choose more stable

traditional pedagogical strategies such as lectures (Moore & Kearsley, 1996; Willis, 2000). The one changed component, faculty, does not respond as the setting is spiraling into another plane where it appears to ripple into an ever-changing environment. Hence, faculty members remain stagnant as changes ripple into what appears to be an unfathomable black hole.

Technology has the flexibility to change the setting; however, changes have not substantially occurred within faculty members' teaching practices (Kearsley, 2000; Marra & Jonnasen, 2001). Thus, having the power to employ innovative changes does not automatically create a receptive environment. Papert (1997) believes planned change needs to be rejected for a better approach of creating conditions for change. Although recognizing limitations of planning is important, the product of change needs to be replaced with the process of change where "the setting has been deliberately transformed from a previous state to a new one" (Fullan, 2001, p. 103).

In this chaotic setting, technology has conflicting functions. Some view it as a powerful tool to instigate changes; others assume technology can be controlled (Bowers, 1988; Fox, 2001; Hodas, 1993). A constant in technology-driven environments is change (Willis, 2000). Therefore, the following section addresses the second question on technology's function: What are the consequences of downplaying technology's function within an educational setting?

Technology's non-neutrality

By examining the change communication model and its individual components, change appears to be driven by individuals' experiences and perceptions. Although the models' approaches are different, change is accomplished by maneuvering or adapting individuals' values and beliefs to a particular innovation (Fullan, 2001; Wilson et al., 1999). When they are confronted with technological barriers, it is attributed to their lack of technical knowledge and skills. So, it appears they control the process (Ellsworth, 2001). While individuals play a role in the activity, other components in the cultural setting, such as technology, are ignored (Grossman, Smagorinsky, & Valencia, 1999; Wilson, et al., 2000).

Some believe, technology influences culture, transforms human experiences, and acts more like a change process than a delivery system (Bowers,1988; Ellul, 1964; Fox, 2001; Postman, 1993; Willis, 2000; Winner, 1977). These beliefs challenge its perceived function in the change communication model as being neutral and acted upon by individuals (Fox, 2001; Hodas, 2001). By adopting this perception, faculty members appear to be assured that their roles, positions, and relationships remain the status quo (Hodas, 1993).

Technology is also heralded to the public as a catalyst for change, while within the classroom; technology is adapted as a tool to support current practices (Hodas, 1993; Wilson, 2001b). This is a first-order change where current practices become more efficient by using technology; however, change does not penetrate the underlying rules and structures of the setting (Elmore, 1996; Wilson, et al., 2000). Hence, sustained change in technology-driven environments has not materialized

when components such as technology are controlled or manipulated (Bowers, 1988; Fox, 2001; Fullan, 2001; Kling, 1996).

For example, through communication technologies, faculty members efficiently transmit information through web pages and create discussions through postings. However, reading off printed pages is quite different from reading off a computer screen where readers are less accurate and slower (Schriver, 1997). On one hand, the efficiency of the technology enabled teaching; while on the other, the efficiency does not address unintended consequence of the computer screen influencing readers' accuracy and speed of reading the material (Schriver, 1997). There exists a duality in this setting where technology is constantly interacting with humanity who is simultaneously praising the efficiency of it and trying to escape from resulting unintended consequences of its use (Ellul, 1964; Fox, 2001; Postman, 1993; Winner, 1977).

By simplifying the change process to an efficient and linear procedure, similar to a flow chart, change agents devalue the importance of the contextual setting and ignore the complex interactions among all elements (Bowers, 1988; Grossman, et al., 1999; Wilson, et al., 1999). Although the goal is to create a universal application, the method converts a social institution into a predictable, controllable, and efficient machine (Bowers, 1988; Ellul, 1964; Jones, 1995; Postman, 1993; Sclove, 1995; Talbot; 1995).

Teacher education, as a social institution, is a complex setting where faculty members create contextual learning environments (Bransford, et al., 2000; Jonassen & Roherer-Murphy, 1999; Miller & Stayton, 1999; Pacheco, 2000). There appears to

be a discrepancy between applying efficient change procedures to complex contextual activities. These activities are as unpredictable as the unintended consequences that emerge over a period of time (Fox, 2001). Without recognizing technology's function in this setting and creating the conditions for change, change is limited to superficial first-order change, which is often unsustainable (Elmore, 1996; Wilson, et al., 2000). Hence, enthusiasm of using technology needs to be balanced with a critical perspective.

To transform this contextual setting beyond efficiency, a deeper level of understanding of the processes and interactions among all the elements provide a foundation for a second-order change (Bateson, 1972). This change goes beyond efficiency of existing practices to creating evolutionary ones (Wilson, et al., 2000). An approach to prepare for the conditions of a second-order change is best explained through an information ecology perspective.

This setting occurs within information ecology where the ecology is a "system of people, practices, values, and technologies in a particular local environment" (Nardi & O'Day, 1999, p. 50). Local is defined not by distance but by the influence of that ecology, which provides a different point of intervention as compared to viewing the larger system (Nardi & O'Day, 1999; Postman, 1993). For example, with communication technologies, the ecology is not defined by a physical border but by the commitment to participation and engagement toward shared goals (Nardi & O'Day, 1999).

Within this ecology, technology has many functions from one as a tool that provides utility, to the function of text that carries social meaning. However, the

system function of technology has brought the most concern, where the efficiency of technology has become the dominant human value (Ellul, 1964; Nardi & O'Day, 1999). Ellul refers to this as technique (1964). Technique is autonomous where it proceeds under its own power without control by people and appears to be exasperating at the macro-level (Ellul, 1964; Nardi & O'Day, 1999; Winner, 1977). Although technique is recognized in information ecologies, the focus is on the micro-level where the choice is "to respond with initiative that is grounded in local understanding and values" (Nardi and O'Day, 1999, p. 56). By examining cultural tools and practices at a much smaller scale, information ecologies shed a different understanding of socially shared and valued activities (Nardi & O'Day, 1999).

In summary, educational change has been planned by selecting one element from the educational setting, changing it, and expecting others to follow suit (Fullan, 2001; Wilson, 2001b). By applying planned approaches, changing faculty's practice is an overwhelming task (Grossman, et al., 1999). Within technology-driven environments, change agents, faculty, view technology as controllable and use it to support current practices resulting in a first-order change (Bateson, 1972). Although planned change has been used in technology-driven environments, the literature does not show sustainable changes (Elmore, 1996; Fullan, 2001; Goodlad, 1999; Guthrie, 1999; Wilson, et al., 2000).

If the attention is shifted from a single element, such as instruction, to the educational setting, then the outcomes become more sustainable (Grossman, et al., 1999). Therefore, creating conditions for change enhance the flexibility in the change process. In this process, spontaneous ideas or unintended consequences influence

dynamic, power relationships and underlying values in the complex educational setting (Papert, 1997; Sarason, 1990; Sirotnik, 2001).

I propose, in a technology-driven environment, that activity theory is a different lens to examine educational change. Instead of focusing on the innovation, this framework describes interactions and practices and identifies emerging contradictions within a local community (Hall & Hord, 1987; Rogers, 1995, Wilson, et al, 2000). Activity theory is also a powerful and clarifying descriptive tool rather than being predictive (Nardi, 1997; Wilson, 2001). The following describes activity theory as applied with teacher education. The origins of this framework are described first followed by each generation.

Alternative Framework: Activity Theory

Creating conditions for change within activity theory includes examining the contextual setting where change occurs. Within this setting, there are dynamic interactions of events called activities (Grossman, et al., 1999; Papert, 1997). Within these activities, there are elements interrelating at multiple levels. These interrelationships reflect a dependency; changing one element influences all of them. Although technology is an element, it is not the focal point of the activity (Nardi & O'Day, 1999). These activities, as explained in activity theory, describe cultural tools and practices interacting within the ecology (Wilson, et al., 2000).

Activity theory was initiated by a group of Russian psychologists as an alternative approach to psychoanalysis and behaviorism (Vygotsky, 1978). This framework was applied in educational settings for the "psychology of play, learning,

cognition, and child development" (Engeström & Miettinen, 1999, p. 2). Originated by Lev Vygotsky, he proposed the concept of "artifact-mediated and object-oriented action" (Vygotsky, 1978, p. 40). This concept, as illustrated in Figure 2, was structured where the relationship between the subject and the object was mediated by cultural tools and signs. Hence, an individual did not directly react to the environment but through mediation by cultural means, tools, and signs (Vygotsky, 1978). This first-generation created the idea of mediation as a foundation for activity theory.

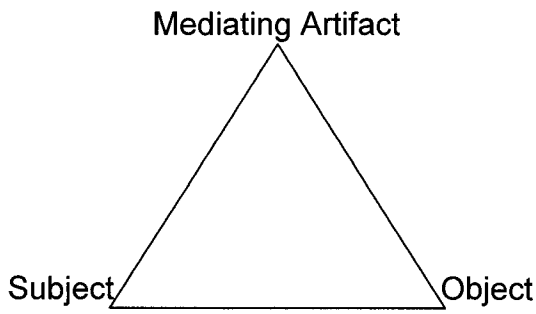

Figure 2. First-generation mediated activity.

For example, a student (subject) uses a pen (tool) to write the required essay to pass a composition course (object). The pen enables the student to express ideas on paper; however, it also restricts the student in using the pen in only this manner. Other features or possibilities are hidden from the student based on the historical context surrounding the pen at that time. Tools change over time (calligraphy and ink well to the ball point of today) and influence mediation between subject and object. Based on historical changes through time the pen moves beyond writing on paper,

to opening a box, or telling time in the future. The pen's mediation function changes as the history of its use is modified with each generation of students.

However, Leont'ev (1981) was credited with the formulation of an activity as described by modern theorists. He distinguished between a collective activity and an individual action where an individual was not isolated in relation to others. This formed the basis of a hierarchical model where activity, action, and operations were defined.

This hierarchy is still used today. The first level of the activity is the achievement of the object/motive by the community. The second level is the action where an individual or group achieves a goal. The last level, operation, is the achievement of the condition by developing a routine by the individual or possibly the machine (Leon'tev, 1981). The framework, as shown in Figure 3, only appears to be the elements interacting; however, there are also integrated levels that create a dynamic setting between and among activities.

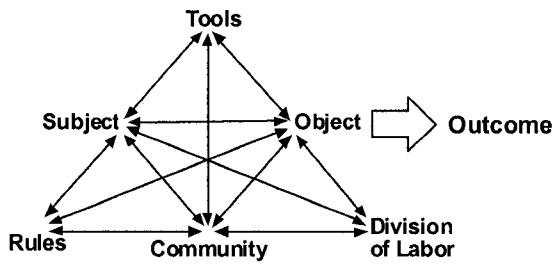

Figure 3. Second-generation activity system.

For example, teacher education has many settings from university coursework to field experience. Within these settings are numerous activities that

dynamically interact with each other. Within field experience, some pre-service teachers are creating electronic portfolios that document application of pedagogical understanding. This is an example of an activity. Pre-service teachers are also performing many actions in order to complete this portfolio, which is the motive or object. One action is designing the layout of the portfolio (goal). In order to accomplish this goal, they need to be conditioned to achieve a certain level of skills, such as layout design. This design includes being able to perform operations such as commands in software programs. This example is not rigid and isolated from other activities occurring within teacher education. Changes in one activity influence another. In this instance, electronic portfolio (activity) becomes an action of another activity (graduation requirements) when the portfolio is an integral part of the process (Kuutti, 1997). The hierarchy of the model creates dynamic and interrelated process that provides a method of describing and mapping influences and intricacies within the setting.

Although activity theory evolved from Vygotsky's description (Figure 2), the graphical model did not until it expanded the nodes or elements with communities, rules, and division of labor (see Figure 3) as noted by Engeström (1987). An activity, as illustrated in Figure 3, is a "form of doing, directed to an object, and activities are distinguished from each other according to their objects" (Kuutti, 1997, p. 27). The subject in this activity is trying to achieve the object within a community, which has rules and roles (division of labor) (Cole & Engeström, 1991; Drewes, 2001; Kaptelinin, 1997; Lewis, 2000). Because of the reciprocal nature of mediation; tools, rules, and division of labor affect actions within the community (Bellamy, 1997).

Interactions among the elements are also as dynamic as the hierarchy of the activity, which in Figure 3 is denoted by the bi-directional arrows.

Within a technology-driven environment, Kuutti (1997) uses these elements to develop a classification of supporting activities. This classification has been adapted and shown in Table 3 (Kuutti, 1997, p. 36).

Table 3. Classification of supporting activities by information technology.

Activity Elements	Operation Level Support	Action Level Support	Activity Level Support
Tool	Automating routines	Making tools and procedures visible and comprehensible	Enabling the automation of new routine or construction of new tool
Object	Providing data about an object	Making able to manipulate an object	Enabling something to become a common object
Actor (Subject)	Triggering pre-determined responses	Supporting sense-making actions within an activity	Supporting learning and reflection with respect to the whole object and activity
Rules	Embedding and imposing a certain set of rules	Making the set of rules visible and comprehensible	Enabling the negotiation of new rules
Community	Creating an implicit community by linking work tasks of several people together	Supporting communicative actions	Enabling the formation of a new community
Division of Labor	Embedding and imposing a certain division of labor	Making the work organization visible and comprehensible	Enabling the reorganization of the division of labor

For example, within distance education, faculty members choose communication technologies to provide support for a learning activity. Web pages are used to post rules of conduct or students decide to enter a chat room to negotiate rules of conduct within a community of learners. Discussion group postings also support the development of the community and provide a social place for students to share

ideas and to help others solve problems. Although this table has rather broad descriptions of classifications, this concept is adaptable to particular settings.

Based on the second generation of activity theory, Cole (1988) observed the lack of cultural diversity or multiple perspectives being represented in the model. He believed that these perspectives influenced and emerged from interacting activity systems (Cole, 1988). This resulted in the development of the third generation, which addressed these issues (Center for Activity Theory and Developmental Work Research, 1998; Cole, 1988; Lewis, 2000). This generation differed from previous ones by expanding the model to include at least two interacting activity systems as shown in Figure 4 (Center for Activity Theory and Developmental Work Research, 1998; Cole, 1988; Lewis, 2000).

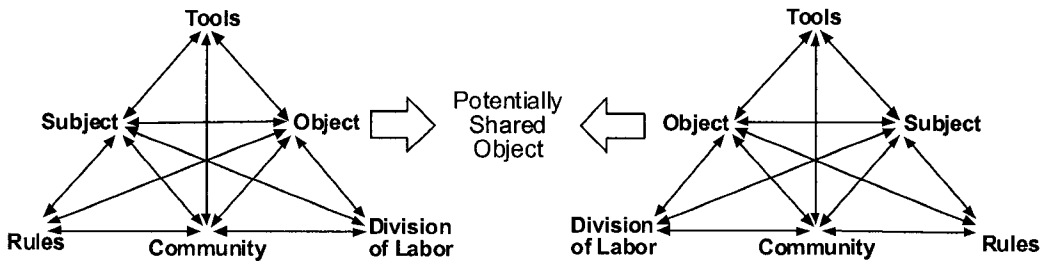

Figure 4. Third-generation minimal two interacting activity systems.

An activity system receives rules and tools from other systems while producing outcomes for others (Drewes, 2001). Problems and conflicts within systems and between systems are identified as contradictions, which motivate development (Turner, Turner, & Horton, 2001). These contradictions, as described by Il'enkov (1977), are constantly being worked through within the activity and

between activity systems. In essence, this system is continually in flux, which provides an understanding in the development and growth of that activity (Center for Activity Theory and Developmental Work Research, 1998; Engeström, 1987; Nardi, 1997). There are four levels of contradictions: (1) primary, (2) secondary, (3) tertiary, and (4) quaternary (Il'enkov, 1977). The relationship among these levels of contradictions and the activity is illustrated in Figure 5 (Center for Activity Theory and Developmental Work Research, 1998).

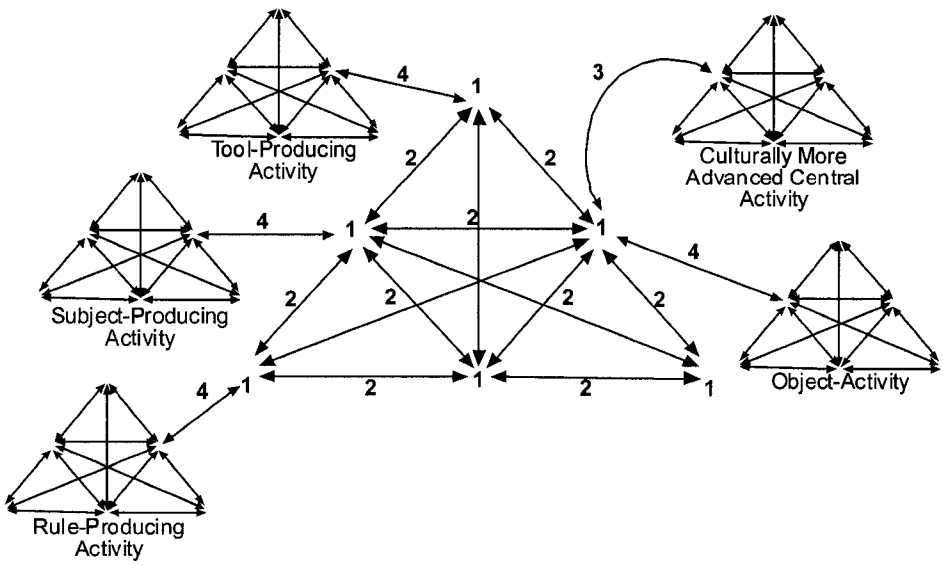

Figure 5. Levels of contradictions in activity systems.

For example, teacher education programs are implementing distance education courses to enhance programs and to access more remote students. Some programs are collaborating by sharing graduate courses. The first level of contradiction, primary, is the cost of implementing communication technologies. Although on-line courses provide access, the cost of obtaining equipment, training

faculty, providing help for students, and maintaining equipment may not offset the benefits of implementing distance education. A secondary level contradiction is faculty sharing responsibility of creating and implementing the course with a larger community consisting of technical staff and administrators. This is contradictory to the normal isolated process of preparing courses by faculty. By sharing best practices of teaching and learning, a tertiary level contradiction is identified. A traditional model at one university is exposed to another university's innovative approach to motivating students to participate in discussions and results in challenging traditional practice. A quaternary level contradiction is the Registrar Office at a traditional university is confronted to change its conventional policy of listing courses on students' transcripts. This policy lists only those courses that are taken at that particular university. By taking a shared course offered by another university, this course is recorded on the transcripts as an independent course with an instructor of record rather than reflecting the shared course.

In summary, activity theory is a cross-disciplinary framework for studying human practices in varied settings at both the individual and social levels where the object is to understand interactions and to identify contradictions (Hung & Chen, 2001; Kuuti, 1997; Nardi, 1997). This approach is a complex method of describing dynamic interactions of people using tools to achieve a purpose and provides a different perspective in teacher education programs (Peal & Wilson, 2001). Moreover, activity theory illustrates that technology is part of the general process of cultural evolution that forms a relationship with educational change (Bellamy, 1997; Leont'ev, 1981). Activity theory can be used to describe the conditions for change

where "the question is not to discover which cause accounts for all change, but rather to ask under what circumstances do particular kinds of change take place?" (Grossman, et al., 2001, p. 3; Papert, 1997).

Conclusion

The purpose of this paper is to present from teacher education perspectives relevant educational change literature as applied in technology-driven environments. Although teacher education programs have been slow to change, distance education has subtly challenged conventional policies and practices. Literature shows that universities including faculty and administration offices have found it difficult to know how to use technology and how to apply it within the learning process. With the rapid changes in technology, particularly communication technologies, planned changes have resulted in innovations not being adopted or being adapted to current practices. Hence, changes have not been sustained in teacher education (Fullan, 2001).

Educational change models, as described by Ellsworth (2001), were presented with cases in practice of teacher education programs adopting distance education components. However, this approach did not address some issues in the complex environment of teacher education. These issues of planned change and technology's function in the change process led to more questions on how effective Ellsworth's model was within this setting. Without broadening the scope beyond planned change to accommodate unintended consequences of adopting an

innovation, the change communication model restricted the focus to a controlled and isolated situation of an environment that is in reality dynamic and interactive.

The common approach to educational change is to change individual teachers. This task is overwhelming and assumes the environment remains constant during these changes. Technology also brings to this environment chaos and conflicting functions that instigate changes rather than being controllable. The constant in a technology-driven environment is change. Therefore, technology-driven environments create complex settings that go beyond focusing on planned change. An unconventional method is to shift the focus from isolated components to the educational setting. Change does not happen in a vacuum, but within personal and meaningful social contexts. Creating the conditions for change enhance the flexibility of the change process as unintended consequences influence relationships and values in complex settings.

This alternative to changing single components is to examine the setting through an activity theory lens. Activity theory provides a practical application at individual and social levels where the object is to understand interactions and to identify contradictions. These contradictions are motivators for change. The intent of using activity theory is not to dissect change, but to describe and create the conditions for change by identifying unintended consequences emerging from dynamic settings.

Activity theory demonstrates examining the relationship among the elements of a sociocultural environment as activities formulate and seed the formulation of other activities. Moreover, faculty members do not view one element of change, but

rather, focus on particular instances of change. In other words, change is not defined by the difference between the beginning and ending stages, however, meaning is derived from the formulation of activities that lead to change.

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MAKING CHOICES IN DISTANCE EDUCATION: REDISCOVERING PEDAGOGY IN A TECHNOLOGY-DRIVEN ENVIRONMENT

A paper to be submitted to the *Journal of Research on Computing in Education*

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Introduction

Currently, Internet technologies have the possibility of transforming distance education from passive teacher-directed instruction to interactive, learner-centered environments (Armstrong, 2000; Cuban, 2001; Freire, 1998; Geer, 2000; Willis, 2000; Wilson, 2001). However, this transformation is limited by faculty members' choices of pedagogical tools (e.g., lecture, classroom discussion, and simulations) (Lee & Reitano, 2000; Marra & Jonassen, 2001; Tyack & Cuban, 1997). For example, communication technologies (e.g., e-mail, threaded discussions, real-time conferencing, and groupware) are used to create virtual learning environments that minimize wait time for feedback, enhance interaction, and maximize the benefits of using video, audio, text, and tactile components simultaneously (Geer, 2000; Kearsley, 2000; Moore & Kearsley, 1996; Palloff & Pratt, 1999). Yet, on-line instruction generally replicates the traditional brick and mortar approaches of

teacher-directed lectures (Dede, 1996; Lee & Reitano, 2000; Marra & Jonassen, 2001).

The purpose of this paper is to present lessons learned as faculty members explore how to harness the power of technology and pedagogically create a virtual learning community for doctoral students located in two geographically separated educational technology graduate programs. This shared course is part of the initial steps of transforming these programs by collaborating through technology-driven environments. A rich description of two faculty members seeking to use technology to establish an on-line collaborative community is presented. This paper begins with a review of the literature on pedagogy in distance education, followed by a description of the research methodology chosen for this study. After the methodology section, results from faculty data are presented, followed by a discussion of these results.

Pedagogy in Distance Education

Pedagogy is defined in Webster's Dictionary (1996) as the "art and science of teaching" (p. 1428) and by Gage (1978) as the "scientific basis for the art of teaching" (p. 20). Gage (1978) describes teaching as "any activity on the part of one person intended to facilitate learning on the part of the other" (p. 14). In his description, scientific basis consists of lower-order interactions between two variables, while art consists of higher-order interactions between four or more variables (Gage, 1978). By identifying the level of complexity in the environment (number of variables), faculty members choose to focus on the degree of learning an

objective (scientific basis) and/or to understand the complex interactions within the environment (art) (Gage, 1978). For example, within distance education, faculty members focus on students learning course material when interactions are between student to content and student to teacher. Faculty members also choose to create a community of learners where interactions are expanded beyond the individual student to an integrated web of communication among many variables.

Although Gage believes both scientific basis and art are equally important, currently, faculty members are struggling between which one to practice (Bransford, Brown, & Cocking, 1999; Cuban, 2001; Gage, 1978). Some believe there lacks scientific research to support knowing how to teach. While, others believe there lacks an understanding of the ever-changing educational activity brought about by rapid development of technology use in teaching and learning (Bransford, et al., 1999; Cuban, 2001; Darling-Hammond, 1997; Elliott, Kratochwill, Littllefield Cook, & Travers, 2000). Both viewpoints vary according to underlying pedagogies and corresponding learning theories (Marra & Jonassen, 2001).

Historically, transmission pedagogy has formed the basis for teaching at a distance, which has its roots in behaviorism and early cognitive psychology (Bransford, et al., 1999; Marra & Jonassen, 2001; McDonald & Postle, 1999; Schieman & Jones, 1996). This pedagogy is defined as faculty conveying knowledge to students who are expected to absorb this knowledge (Bransford, et al., 1999; Palloff & Pratt, 1999). Although used in distance education, transmission pedagogy reflects the factory efficiency of 19th century mass education while being used in the technically advanced 21st century (Bransford, et al., 1999). For example, faculty

members begin their on-line lectures by displaying topics being covered on a Microsoft PowerPoint slide (Kearsley, 2000; Schieman & Jones, 1996). These topics are presented in sequential order, which capitalizes on the efficiency of transmitting this information to students (Dabbagh, 2000). Technology's function in this transmission is often viewed as a delivery tool (Elmore, 1996).

Although technology has evolved dramatically from print-based used for correspondence studies to Internet-based for virtual learning environments, faculty members have not changed their pedagogical tools (e.g., lectures) (Geer, 2000; Kearsley, 2000; Norton & Sprague, 2001; Parker, 1999). By relying on lectures, they limit their pedagogical flexibility as they encounter the complexity of technology-driven environments. These lectures are based on perceived pedagogy-free material, which has been developed by course developers (Lee & Reitano, 2000; Marra & Jonassen, 2001). On-line course developers believe that these materials teach independently through technology (e.g., WebCT) (Firdyiwek, 1999). This leads to a disparity between pedagogical beliefs and technology's capabilities.

For example, web-based courseware such as WebCT contains several tools that may have been selected by technical administrators prior to faculty use. The tools' convenience determines a more favorable selection such as objective testing tools (Firdyiwek, 1999; Marra & Jonassen, 2001). This selection overrides pedagogical preferences by faculty. Faculty members choose to implement complex activities that include developing group projects, presenting those projects to the whole class, evaluating it by group members then separately by the class, and debriefing with group members. However, as designers, faculty members only view

the group projects in the student presentation tool and have to use several tools to accomplish the varying levels of assessment (e.g., student presentation, discussion group, chat, e-mail, and assignment dropbox). Complex activities through WebCt require more planning as compared to using a convenient quiz/survey tool for objective testing. Hence, faculty members find it difficult to use technology when it does not support their preferred learning process. On the other hand, on-line course developers overlook the importance of pedagogy when well developed units are more efficient in technology-driven environments (Bernard, Rubalcava, & St-Pierre, 2000; Hemming, 1999; Kearsley, 1998; Palloff & Pratt, 1999).

From this complicated environment, negative consequences emerge. These consequences are high student dropout rate, student isolation, frustration with lack of technical expertise by both student and faculty, and low content retention by students (Bernard, et al., 2000; Dabbagh, 2000; Hara, 2000; Marra & Jonassen, 2001). The causes of these consequences have ranged from low quality instruction, student characteristics, lack of best practices, and technological influences (Fox, 2001; Hara, 2000; Kirby & Garrison, 1992; Marra & Jonassen, 2001). For example, although WebCT has a discussion group tool, faculty members lack time to implement it based on limited incentives for developing problem-based questions, monitoring discussions, and responding to students' questions (Collis, 1997; Marra & Jonassen, 2001). Although the discussion tool supports more interaction, the social aspect of learning is downplayed or non-existent when faculty members lack the incentive to increase interaction and opt for simpler tools to transmit content (Bates, 1995; Marra & Jonassen, 2001).

Transmission pedagogy has often been used by faculty in distance education; however, interaction is limited with students interacting with content (e.g., web pages, lecture notes) or faculty lecturing to students (e.g., audio tapes) (Berge, 1995; Jonassen, Peck, & Wilson, 1999). This is referred to as one-to-many communication level (Paulson, 1995). Another type of interaction is social activity where learners (including faculty) are interacting with each other and the environment (Berge, 1995; Jonassen, et al., 1999; Repman & Logan, 1996). This is referred to as many-to-many communication level (Paulson, 1995). Based on many-to-many communication, faculty members are currently attempting to develop on-line courses using learner-centered pedagogy (Hemming, 1999; Palloff & Pratt, 1999).

Learner-centered pedagogy is engaging learners in the construction of knowledge through collaborative activities where learning is embedded in meaningful context (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). This pedagogy is based on constructivism and cognitive science (Jonassen, et al., 1995). Although it has a strong theoretical foundation, most of the theoretical work began prior to the development of the Internet (Hemming, 1999). Hence, faculty members are trying to interpret this theory within the context of technology-driven environments (Bonk & Cunningham, 1998; Hemming, 1999). There lacks pedagogical guidance to understand how to integrate technical tools with practice; therefore, faculty members are simultaneously changing their pedagogy while experiencing innovative technology (Bonk & Cunningham, 1998).

By shifting pedagogy from transmission to learner centered, faculty members create virtual learning environments based on quality interaction and not on

efficiency (Harasim, Hiltz, Teles, & Turoff, 1995). For example, instead of using the content tool in WebCT to post lecture notes in Microsoft PowerPoint presentations, faculty members use the discussion tool to guide in-depth conversations within a learning community. Along with these changes in pedagogy, faculty members are also experiencing technical influences within this setting (Archer, Garrison, & Anderson, 1999; Nardi, 1997; Wilson, 2001).

With rapid advancement of Internet technologies, the conditions for supporting pedagogy have changed (Bates, 1997; Markle, 1999; Marra & Jonassen, 2001; Ragoonaden & Bordeleau, 2000). With increased flexibility, communication technologies support more visual cues, timely feedback, interactivity, and community building (Bernard, et al., 2000; Bivens & Chute, 1996). These communities foster discourse where learners negotiate meaning and share perspectives (Fosnot, 1992; Lave & Wenger, 1991). Faculty members create a pedagogically sound environment by using technology to incorporate active learning, knowledge construction, community development, and interactivity (Collis, 1997; Geer, 2000). However, face-to-face pedagogical tools are not enough as students and faculty are conversing in a synchronous environment where additional strategies are needed (Bivens & Chute, 1996).

New pedagogical tools are needed for technology-driven environments. These pedagogies include modeling collaborative behavior, creating social climate for learners, constructing problem-based contextual tasks, and using multiple Internet components to support learning (Bernard, et al., 2000; Whipp & Schweizer, 2000). However, faculty members are overwhelmed with the rapid growth in on-line

course offerings. These offerings have increased as a result of economic pressures, technological innovations, and competition for student enrollment (Hodas, 1993; Marra & Jonassen, 2001; Willis, 2000).

To transform faculty members' practice, conditions for change are needed to enhance sustainability as faculty members engage learners within a dynamic learning environment influenced by changes in technology. An approach to examine this environment, activity theory, also has roots in constructivism. By focusing upon varied individual elements in an environment, activity theory describes interactions and practices within the educational activity and identifies consequences or contradictions emerging within the local community (Wilson, Sherry, Dobrovolny, & Ryder, 2000). Although activity theory is not a strong predictive tool, this framework does clarify and analyze the educational situation including the intentions, tools, and culture (Nardi, 1997; Wilson, 2001). Activity theory is a descriptive tool that examines human actions through multiple perspectives. Therefore, activity theory provides faculty members with an understanding of the complex nature of the dynamic educational activity within technology-driven environments (Walker, 2004c). The following describes activity theory as it is applied within a distance education setting.

Activity theory

Historically, this framework's foundation began with Vygotsky's belief that an individual (subject) by using a supporting tool (mediating artifact) was motivated to achieve an object (1978). However, over the years, it was expanded beyond the

interactions of three elements to dynamic interrelationships among six elements. These elements are subject, tools, object, rules, community, and division of labor (Kuutti, 1997). A triangular framework, as shown below, (Figure 1) illustrates the relationship among the elements (Cole & Engeström, 1991; Engeström, 1987).

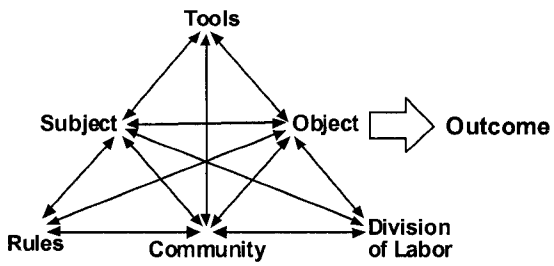

Figure 1. Activity system.

An activity system distinguishes itself from other systems by the object that the subject and community try to achieve (Kuutti, 1997). For example, faculty (subject) uses pedagogical strategies and communication technologies (tools) as a motive of achieving the course objectives (object). Other faculty members, technical support staff, and administrators form the expanded community. The rules of how to use the equipment, how to train staff, and who receives training, support the goals and conditions between faculty and the community. This community divides its responsibilities by levels of expertise such as technicians maintaining the equipment, staff scheduling rooms, administrators sharing with other programs, and faculty explaining pedagogy.

Besides interactions among the elements of an activity, the process also includes hierarchical interaction among layered levels. Within an activity, there are

actions and operations supporting the overall process (Leont'ev, 1981). For example, faculty members learn how to use an electronic whiteboard as a means of sharing documents simultaneously with another site. The activity is the creation of a shared document as a result of a brainstorming strategy. In order to accomplish this activity, there are numerous actions taking place, such as understanding what is brainstorming. A sample operation for this activity is the knowledge of Microsoft Word commands that enable faculty to implement this strategy.

These examples create dynamic movement that is chaotic but descriptive of an activity within a contextual setting. An activity is a dynamic complex process of interactions among elements that forms a supporting foundation of layers. In practice, Hung, Koh, and Chua (2000) describe a method of applying activity theory within research, which has been adapted in Table 1.

Table 1. Application of activity theory (Hung, et al., 2000, p. 31).

Topic	Interaction Triad	Application
Pedagogy	Faculty - Technology -Object	Interactions among faculty to students, students to students, and students to content that are supported by pedagogy within technological influences.
Mediational Tools	Rules -Technology -Division of Labor	Facilitation or automation of the global interactions within the activity.
Management	Faculty - Rules - Community	Guidelines or procedures, such as Netiquette, of how and when interactions occur locally.
Roles	Community -Object - Division of Labor	Distinguishes who has within the community has particular tasks to accomplish the object at a global scale.
Process/Product	Faculty - Community -Object	Methods of interactions that enhance achievement of the product or object. Unlike mediation, this is on a smaller scale.

This table provides an understanding of how to apply activity theory within an educational setting. Faculty members, in this setting, choose pedagogical strategies to support the creation of an on-line collaborative community. Within this technology-driven environment, students negotiate rules for interacting with each other and share their expertise as they enhance the growth of the community in achieving learning.

Activity theory is a process of analyzing human practice within context at the individual and social levels of interaction (Hung, et al., 2000; Jonassen & Roherer-Murphy, 1999; Nardi, 1997). While Figure 1 illustrates one activity, within a social environment, there are several interacting activities as shown in Figure 2.

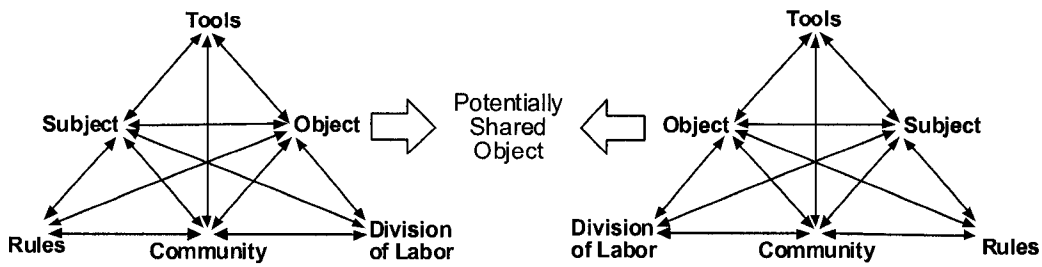

Figure 2. Interacting activity systems.

Within an activity and between other activities within a system, problems and conflicts are identified as contradictions that motivate further development and understanding (Turner, Turner, & Horton, 2001). In the previous example under transmission pedagogy, activity theory is used to identify negative consequences that emerge in distance education activities such as isolation and technological influences (Il'enkov, 1977). There are four levels of contradictions as identified by

Il'enkov (1977): (1) primary, (2) secondary, (3) tertiary, and (4) quaternary. These are illustrated in Figure 3.

For example, for the primary level, faculty members lack access to training on WebCT courseware. This contradiction emerges from lack of funding for normal expenditures of using technology. A secondary level contradiction is faculty members encountering a new feature in WebCT and trying to develop pedagogical strategies that are supported by this new tool. This contradiction exists between current elements in the activity as a new element from outside of this activity is introduced. Faculty learning a new process of teaching with WebCT at a professional conference is a third level contradiction.

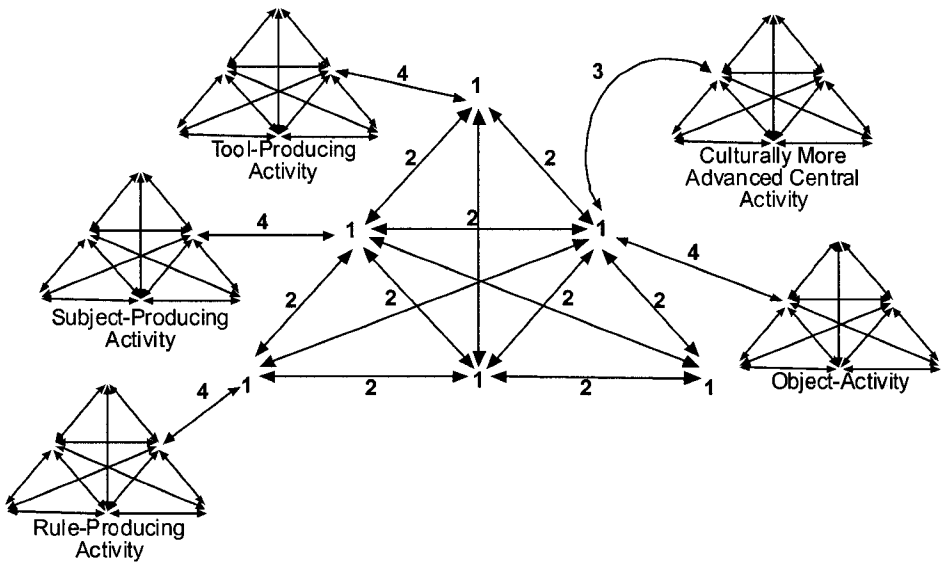

Figure 3. Levels of contradictions.

This contradiction emerges when there is resistance to using different and more advanced objects. The last contradiction is the interaction between education faculty

and engineering faculty on the acceptance of an education pre-requisite for an engineering student. Within and between these activity systems, conflicts and misunderstandings frequently emerge.

In summary, faculty members have used transmission pedagogy to transmit content to geographically separated students. The use of lectures and other transmission pedagogical strategies have negative consequences such as high attrition and low retention by students. However, changes in learning theory and rapid advancement in technology have presented faculty with other possibilities in distance education. With communication technologies, faculty members have the possibility of implementing pedagogy that supports construction of a community of practice (Wenger, 1999). This community reduces distance and supports interactions among learners. Therefore, distance education becomes an environment that supports learner-centered pedagogy.

While changes in theory and technology influence this environment, activity theory describes faculty members' experiences and influences and identifies emerging contradictions within complex and dynamic learning activities. By presenting this framework, faculty members examine the cultural setting as they implement learner-centered strategies to sustain changes within technology-driven environments. Prior to describing faculty members' experiences in this study, the research methodology is presented next. In the following section, setting and subjects are described. Then, types of data collected are explained with the research methodology section concluding with data analysis.

Research Methodology

Case study methodology has been chosen to better present rich description (Geertz, 1973) of the lived experiences (Van Manen, 1990) of the participants within an educational setting. Case study is a detailed examination of the complexity of a contextual setting or particular event where the researcher presents participants' understanding of the setting or activity observed (Stake, 1995). The researcher observes interactions within this setting, describes complexities, and notes unusual instances (Stake, 1995). An important characteristic of case studies is the participatory relationship between participants and the researcher (Stake, 1995). By using a case study approach, the whole setting is described from participants' perspectives.

When technology is used within these settings, Rogers (1995) believes the consequences of using technology have not been properly addressed. The effects of technology also need to be examined over a period of time using a case study approach (Rogers, 1995). Within technology-driven environments, faculty members experience changes in their pedagogy. By describing these changes, this methodology provides an understanding of the setting and the process of change (Willis, Thompson, & Sadera, 1999).

Researchers also use activity theory in a case study to analyze data obtained over a period of time (Vygotsky, 1978). Similar to case studies, activity theory presents an understanding of subjects and community as they achieve the object of the activity as well as noting the unintended consequences within a dynamic and complex setting.

In particular, this study examines faculty members' experiences with sharing a graduate level course with another educational technology graduate program. Instead of isolating the individual elements such as technology; the interactions, influences, and unintended consequences of the whole activity are presented from faculty members' perspectives.

The study has been guided by research inquiries asking: "How do faculty members choose pedagogical tools within technology-driven environments?" "How do faculty members construct a community of practice through this environment?" "What do faculty members discover about their choices of pedagogy?" "What function does technology play?"

Setting

The setting for this case came from an established ongoing collaboration that was eventually formalized in the 'Coalition for Innovation in Teacher Education' (CITE). The overall goal of the coalition was "to identify effective methods of preparing future teachers" (Coalition for Innovation in Teacher Education, 2000, p. 1). Sharing graduate courses was implemented as a collaborative activity between the Curry Center for Technology and Teacher Education at the University of Virginia (UVa) and the Center for Technology for Learning and Teaching (CTLT) at Iowa State University (ISU). In the pilot year 1998-1999, four courses were shared to expand opportunities for students in both ISU and UVa's graduate programs. One of those courses offered by UVa, *Diffusion of Educational Technology: Policy and*

Practice, was the foundation for this case study. The following table (Table 2) provides a timeline of notable events.

Table 2. Timeline of notable events.

Date	Event
April 1998	CITE Leaders brainstormed possible collaborations during meeting at ISU. Did not involve faculty from Diffusion course.
April 1998	Author co-wrote grant for internal ISU RFP.
May to August 1998	UVa received internal money from IMPACT initiative.
May to August 1998	Each program researched technology purchases independently based on university procedures and available vendors.
August 1998	UVa purchased most of their equipment.
July to September 1998	ISU obtained equipment with guidance from UVa.
July to September 1998	Practiced with technical support, which was overseen by CITE Leaders.
September 7, 1998	*Diffusion of Educational Technology* class begins.
September 7, 1998	Started with phone & electronic whiteboard.
September 14, 1998	Discussion groups added, Changed phones at ISU to be more compatible with UVa.
October 5, 1998	Video added.
December 17, 1998	*Diffusion of Educational Technology* class ends.
January 1999	Second group of pilot courses began.
March 1999	SITE conference presentations
Spring 1999 through Summer 1999	CITE Leaders wrote grants and scholarly papers on the collaboration and continued discussions on next steps.
Fall 1999	Some equipment targeted for P-12 schools.
Spring 2000 through Summer 2000	Continued to collaborate with P-12 schools on technology use.

The Course: Diffusion of Educational Technology

In September 1998, two UVa Assistant Professors offered this course with a UVa students having this course listed on their transcripts while ISU students received ISU independent study credit. By sharing the course, students had opportunities to inquire about policy and experience another university's academic and social culture. This course had been offered to UVa students prior to the fall

offering; however, it had not been team-taught. Faculty divided it into two sections: theoretical and practical. The first half focused on the policy theory. The second half of the course examined policy in practice with emphasis on how technology affected policy development. Faculty structured it in a seminar format grounded in inquiry and collaboration.

Subjects

Faculty members, who taught this course, were the focal group for this study. Additional groups included technical support staff and CITE leaders who provided supporting evidence and additional information. In this case study, this course represented a relatively intense effort to use technology and to enable collaboration with another educational technology graduate program. As one of the two pilot courses offered in Fall 1998, there was increased interest in using the technologies and collaborating with another educational technology graduate program. This interest is reflected in the almost double of staff and faculty compared to the number of students. However, a total of 50 students participated in the pilot year. The following table (Table 3) provides a visual of the participating groups for this case study.

Table 3. Groups of subjects.

Group	UVa	ISU
Faculty Members	2	1 Instructor of Record Only
Technical Support staff	3	1 Participant Researcher
CITE Leaders	3	3
Students	3	3

Two UVa Assistant Professors jointly taught this course. One faculty member had previously taught it. Neither of the UVa faculty members had extensive backgrounds in instructional technology, but had used some type of technology in previous courses. Although this course had not been team-taught prior to this offering, the interpretation of team-teaching was different than simultaneous sharing of teaching. By dividing it into two sections, each faculty member was responsible for a section. Although, at times, both were present, the faculty member responsible for the current section led the discussions. The other observed and participated on occasion. The observations were beneficial for the second faculty member as new technologies were added during the first phase of the course.

Faculty members introduced themselves on the first day and provided information on the course web page. For the purpose of this study, the names of the faculty members have been changed.

John, the first faculty member, taught courses in research and evaluation methods. His research interests included the impact of policy on practice in education. John also had experience in policy development as a management policy analyst in the judicial court system. However, he considered himself a novice in using technology in instruction.

Jane, a former public school administrator, was interested in the relationships between social systems, such as classrooms and schools, and the diffusion process that transpired within them. For her, understanding these relationships was crucial to the successful introduction, sustainability, and advancement of teaching and

learning. She described herself as a user of technology and had used discussion groups previously in her teaching.

Technical support staff, attached to this project, consisted of three at UVa and one at ISU. UVa had experimented with this equipment prior to the collaboration and provided expertise and guidance as both programs examined and implemented the technologies. UVa staff also provided technical expertise including the purpose and function for each technology. Part of their instruction was to guide faculty in learning how to technically use the equipment. The novelty of this pilot course increased the technical support provided to address the unfamiliar technology used in connecting the two sites.

CITE leaders consisted of professors, network experts, directors, and other administrators who envisioned innovative approaches to using technology to support the collaboration of educational technology graduate programs. These included sharing cultures, exploring values, and initiating change. Although they were not always involved in the daily activities of the course, they created the collaborative approach to educational change. During this course, CITE leaders also showed off the collaboration by bringing visitors and key administrators to the classroom to watch the course in action.

Six doctoral students (three from UVa and three from ISU) either enrolled or audited the course; most were instructional technology majors. Although students are not the focus for this paper, they provided clarification of faculty members' discussion postings. Class sessions were also video taped, which were used to

observe interactions among faculty and students. This documentation was used for triangulation of emerging themes.

My role, as a participant researcher was a combination of active participant and course observer. I unofficially audited the course and completed assignments, read class materials, and participated in discussions both on-line and during class. Detailed accounts of my observations were kept in a journal. I debriefed my interpretations and their relevance with university professors in educational technology graduate and graduate students who were also taking other shared courses with UVa. I also performed member checks with the participants to clarify my understanding and interpretations. If I recognized or was informed of possible biases coming through my interpretations, I wrote down discrepancies and further discussed it with distance education, technology, and pedagogy experts (such as university professors).

Data Collection

Data collection began in September 1998 and continued through March 1999 when faculty and students made a presentation at an international conference. The data sources included multiple forms: interview transcripts, discussion group postings, meeting audio tapes, video tapes of the course, e-mail and phone messages, field notes, and artifacts (print and web-based materials, course readings, policy documents, and the final course projects).

Data collected provided a rich context of the interactions in the study (see Table 4). The primary source was the interview transcripts. The other data sources were used for triangulation of ideas, concepts, categories, and themes.

Table 4. Evidence gathered for data collection.

Data Source	Subjects	Volume
Faculty Interview Transcripts	Faculty from *Diffusion of Educational Technology*	2 x 1 hour (semi-structured) interviews
Discussion Group Postings	Faculty and students from *Diffusion of Educational Technology*	200 pages [with individual, date, and time stamps]
Observation Field Notes	Observations of *Diffusion of Educational Technology* course	150 pages
	Informal Discussions with CITE Leaders	50 pages of notes
	Informal Interviews and Discussions	50 pages of notes
	Meeting on Internet 2 setup	1 hour meeting with 10 more follow-up hours
Artifacts: Video tapes of course in session	*Diffusion of Educational Technology* course (taped at ISU with visual of the ISU class and video from UVa)	15 x 2 hour tapes (all class sessions)
Artifacts: E-mail Messages & Phone Messages	Faculty, Technical Staff, CITE Leaders, and Students (sent and received by participant researcher)	Average of 2 messages per day from 1998 to 2000
Artifacts: Video & Audio Tapes	CITE Leaders during CITE meetings	1 x 2 hour video tape; 3 x 1 hour audio tapes
Artifacts: Audio Tapes	Faculty, Technical Staff, CITE Leaders, and Students	Invited SITE: 2 hour presentation
Artifacts:	CITE Leaders (Planning documents) UVa and ISU web pages Professional Organizations	5 Documents 10 web pages Policy Documents

Interviews were audio taped and video taped. The interviews contained open-ended questions to better obtain meaningful data (Ely, Vinz, Downing, & Anzul, 1997). The questions, found in the appendix (see Appendix D), were divided into four categories with the fifth being any additional comments. These categories (classroom climate/

culture, technology, consequences, infrastructure) were developed based on literature in distance education and diffusion of innovation. I asked each faculty member the same questions; however, I followed up on their responses to better clarify their answers. Faculty members also provided contextual examples as part of their responses to the questions. The audio tapes were transcribed and printed out for analysis. The video tapes were used to obtain information on their body language and to provide a backup for the audio tapes.

Discussion group postings were printed out chronologically from the newsgroup. Date, time, and subject's name were printed on each page of the postings. These postings included student responses, which were used as supporting evidence or provided context for faculty members' postings. I used two different highlighters (yellow and pink) to highlight students' postings and faculty members' postings separately. The postings were kept in chronological order for analysis purposes.

The field notes were kept separate from the other data collected. I also divided the field notes chronologically. I entered my observations during class. Within an hour after class, on a separate page, I jotted down ideas and feelings of what transpired that class period. At the end of the day, I interpreted what I observed. On a weekly basis, I reviewed my notes and examined them for commonalities and initial categories. For example, I wrote down pedagogical strategies used during class, such as brainstorming. This particular strategy produced a list of key national instructional technology policy personnel. After class, I described the observed feelings and ideas such as taking turns, collaborating with

others, and running out of ideas. At the end of the day, I examined how this task corresponded with meeting course objectives. I also looked at interactions between technology and faculty as the objectives were met or not met.

Artifacts were gathered from the beginning of the course. This included: video tapes of the class in session, e-mail and phone messages sent to me from the subjects, audio tapes of CITE meetings, audio tape of meeting and presentation at a conference, policy documents, print copies of web pages, and other documents. These artifacts provided supporting evidence for emerging themes. For example, the web page was used to inform ISU students about the UVa campus and introduced them to the course basics such as objectives, books, and syllabus. This was the first introduction of faculty members' expectations. The course video tapes were used for triangulation of ideas and concepts emerging from other data sources. As themes emerged, I searched the video tapes for confirmation.

From the initial point of beginning to gather data, I began my analysis of the raw data obtained. The following describes the data analysis.

Data Analysis

The purpose of analysis was to examine data collected to better understand and to present this understanding to others (Bogdan & Biklen, 1998). This process included organizing raw data into manageable pieces, comparing collected data with newly obtained data, rethinking similarities and differences, looking for patterns, understanding the whole as well as its parts, and presenting the resulting information (Bogdan & Biklen, 1998). I chose to begin the analysis as data were collected. This

aided in data management and provided a method of narrowing the scope of the study. In essence, analysis provided an approach to move data from ambiguous to a comprehensive description of the situation (Bogdan & Biklen, 1998).

The following describes this analysis. First, types of data are presented including methods used to examine this data. Next, emerging themes are discussed. This section concludes with an illustration of the connection between the themes and the review of the literature presented earlier, in particular, the connection between the themes and activity theory.

Data description

After the course was completed, I interviewed both faculty members and subsequently transcribed the audio tapes into two separate sets of transcripts. The transcripts were placed in chronological order according to when the faculty member taught. These transcripts were then read as one complete narrative. Therefore, John's interview (taught first half of the semester) was read first followed by Jane's (taught second half of the semester). After the first read for understanding, I reread the transcripts and began underscoring key words and identifying broad topics. This initial examination provided a structure to the data. After reading the complete narrative twice, I went back through the transcripts to begin searching for patterns. These patterns represented topics or categories that sorted descriptive data into meaningful units (Bogdan & Biklen, 1998; Ely, et al., 1997). By developing a coding system, I was able to identify initial categories which were used to compare with other data sources, such as field notes (see Table 5).

Table 5. Coded material from interview transcripts.

Transcript Excerpts	Coding
Question: Did your teaching strategies change?	Categories are in [ ] within the text.
Response: I'd say that they started to change [Pedagogical Change]. In other words, um uh the technology made me come sort of face to face with um uh a couple of issues [Technology's Influences] about um just sort of the idea of using different resources in instruction [Technology's Function]. . . um like I'm basically a lecture and overhead kind of person [Transmission Pedagogy]. . . made me start thinking about um how technology could sort of change the day to day practice [Technology's Influences].	

I also created a visual representing these categories and their relationships as a technique of analysis (see Figure 4) (Strauss, 1987). This visual represented technology's influences as pedagogy was used to support community of learners and technical support implemented varying levels of course administration.

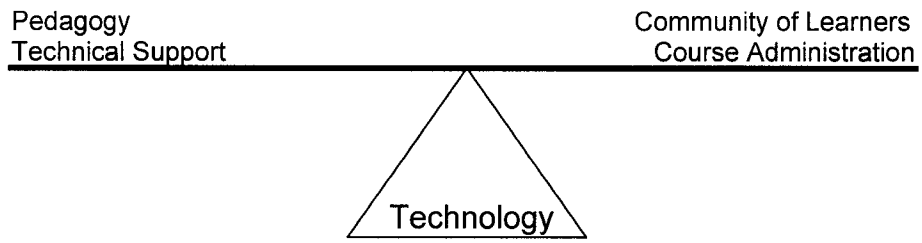

Figure 4. Tentative category visual representation.

The coding system provided a foundation for the emergence of themes. Themes are patterns of order that are systemically found across the data (Strauss & Corbin, 1998). With each subsequent reading of the transcripts and comparison with other data sources, I continually reevaluated the themes. I also asked faculty for

clarification, debriefed with other university professors and graduate students, checked other data sources, and reviewed the literature for corresponding theory.

The following presents this process of reevaluating preliminary categories, as shown in Figure 4, and subsequent emergence of the themes for this study. Each theme is presented with supporting evidence as well as unanticipated instances. The processes of examining these instances are also described as I assessed my biases with these instances with colleagues and participants.

Emerging themes

From the above categories, I reviewed the data, refined my coding, and determined through continual evaluation including checking with external resources, the emergence of themes from the data. This process is described below.

Technology. From the interview transcripts, faculty members repeatedly discussed technology's function in the course. Initially, John believed the best approach for him was to try to ignore technology. However, as more technology was added, he felt challenged in using it to teach content while trying to interact with the Iowa students. At some points he used technology to deliver instruction while at other times he used it as an information vehicle. By the time she taught, Jane learned from observing John what worked and what did not. She was also able to experiment more with technology; because most of the technical glitches had subsided. From the data, technology played many functions throughout the semester as faculty processed teaching and learning in a technology-driven environment.

With technology emerging as a theme, I was initially concerned that it was playing a more subtle role. I weighed faculty members' comfort levels with the identified technology functions. This concern came from my perceived biases based on my understanding and working with the technology. After debriefing with other faculty, I evaluated this position and determined that technology was more prevalent in the process. Although it acted as a fulcrum between teaching and learning, it also influenced faculty members in how they chose to use technology and how they viewed their role during this process. Therefore, technology emerged as a theme.

Pedagogy. From the interview transcripts, field notes, and video tapes of the class, faculty members discussed their struggle with teaching content while creating a learning environment. Pedagogy was interpreted by the faculty as the degree that students learned the content and interacted with others. Both believed pedagogy was at the heart of this course. Their intentions were to choose strategies that supported both instruction and learning. However, within the first weeks, John was not as adventurous in trying new strategies. He was in the process of juggling multiple independent technologies, identifying with both physically local and virtual students, and sharing novelty of the technology with visitors. With John teaching first, Jane had more time to prepare her teaching plan as well as learn from John's experiences.

Both faculty members examined their ability to teach during this course while learning from their mishaps and technical glitches. I had taught distance education courses; therefore, I had insight in what they were experiencing. Based on my previous experiences, I spent time clarifying their responses with other faculty and

colleagues to better understand what was emerging from the data. For example, I believed course administration to be another theme from my observations and field notes. After I conducted the faculty interviews, I found the concern to be more focused on the instructional aspect of the classroom setup. John rearranged the room several times throughout the first half of the semester. At first, my impression was he was dealing with basic course administration, which would be similar to a change in room assignments. However, after the interviews, I determined the focus was not on the actual course administration but the creation of a pedagogically sound environment. I also observed in the course video tapes which provided supporting evidence of John moving the UVa classroom for the UVa students to face the virtual ISU class. The field notes also supported the change in the room arrangement and John's attempt to use different pedagogical strategies with the new arrangement. Subsequently, I expanded the pedagogy theme to be more inclusive of instructional concerns such as classroom practices, strategies, and resources that have a local and immediate utility (Grossman, Smagorinsky, & Valencia, 2001).

Community. From the interview transcripts and field notes, community emerged as a theme. One of the objectives set by faculty was the creation of an on-line collaborative community. This community development provided the foundation for the interaction among students. For example, from the field notes, I observed the classroom setup was modified when John felt the two sites were not engaging in active discourse. In order to meet this instructional practice, each site was arranged where the students were seated around a half circle of tables and chairs. It appeared with this arrangement that they were talking to the other half of the circle as they

looked at the video camera mounted in front of them. Therefore, I observed the illusion of a completed circle when I reviewed the video tapes of the class. As noted above, physical classroom setup was determined to be an expansion of pedagogy. However, here the intention of this strategy was to change the instructional practice from individual learning to group learning. In this case, the practice, pedagogy, intended to create a community. Community at this stage emerged from the learning environment, which in this example involved changes to pedagogy as well.

Although community was a strong focus in the classroom, the data also presented another layer of community consisting of technical support staff and CITE leaders. I envisioned one circle of community directly surrounding the course while another expanded circle observed and supported the internal circle. From faculty interviews and field notes, this expanded circle also emerged.

Within the first weeks, John and Jane were concerned with not being able to operate the equipment and having technical problems during class. For these reasons, they were both comfortable in having technical support staff present before, during, and after class. This presence alleviated concern of having to handle technical problems. However, there were also conversations on how to balance technology capabilities with faculty members' pedagogical preferences. Faculty believed technology needed to follow pedagogy, while from field notes; technical support staff saw technology as more determining of the process. Technical support initially was identified as a category.

From the transcripts and other artifacts, such as field notes and videos, I interpreted further that technical support was a sublevel topic under community. I

was concerned that my biases clouded my interpretation with technical support. My role in this course was also being the ISU technical support staff. I believed with my technical understanding I was interpreting more from the data than what was there. Although there was supporting evidence from the data, after discussions with others, this was a different form of community development as compared with the development in the course.

Within this theme, there were two levels where one community focused on the course content; the other, on a bigger picture supported collaboration between the two programs. Hence, community emerged as a theme with two layers consisting of two groups with faculty being the commonality between the two.

Course administration had been discussed under pedagogy. However, from the field notes, I also found evidence on administering the course from the university's perspective. This evidence included registering for the course and receiving required reading materials from UVa. Although this information provided clarity and background on the setting, this was not a strong category and was explained within the context of the activity. By looking at Figure 2, I interpreted this course administration to be rules and division of labor that mediated the community in achieving its goal. For example, there were discrepancies in how ISU students enrolled in this course. This challenged conventional policy at the Registrar's Office of how courses were listed on students' transcripts. Although transcripts normally reflected the name of ISU courses, ISU students enrolled in an independent study course. This discrepancy was not solved at that time. After debriefing, course

administration was part of the context of the expanded circle discussed in community.

In summary, data analysis and debriefing with faculty and colleagues resulted in interconnected themes of technology, pedagogy, and community. While evaluating these themes, I reviewed activity theory that was previously discussed in the literature review of this paper. From this review, activity theory provided a framework to make sense of the data, in particular, the connection and relevance among data pieces (Maxwell, 1996). The following table (Table 6) illustrates the connection between activity theory and the themes from the data analysis.

Table 6. Connection among activity theory and themes.

Activity Theory	Table 4		Themes
Tools	Mediational Tools	Rules – Technology - Division of Labor	Technology
Tools	Pedagogy	Faculty – Technology – Object	Pedagogy
Subject	Process/Product	Faculty - Community - Object	Community: Course Smaller Circle
Rules	Management	Faculty - Rules - Community	Community: Administration Larger Circle
Community	Process/Product	Faculty - Community - Object	Community: Both Levels
Division of Labor	Roles	Community - Object - Division of Labor	Community: Technical Support Larger Circle
Object	Process/Product	Faculty - Community - Object	(Interactions among the themes)

Activity theory is a framework to describe an educational setting and identify emerging conflicts among the elements of the setting as well as with other settings. One of the elements, tools, is consistent with technology, which emerged as a theme. In activity theory, technology's function is to mediate between the subject and the community as they achieve the object of the activity. In this case, communication technologies mediated the setting as faculty members and the communities achieved the implementation of the shared course. Technology influenced the interactions among faculty and community members as they discovered how to use technology to perform routine tasks. By examining technology's influences from multiple perspectives, the complex interrelationships in this case study emerged from the data collected. Therefore, activity theory is a connection between the data and the technology theme as well as the relationship among other data pieces.

Another theme, pedagogy, is also an example of a tool in this setting. Pedagogy was viewed as a tool that mediated between faculty and the community as they were motivated to achieve the implementation of the shared course. The two tools, technology and pedagogy, also were interacting with each other as each mediated within this setting. With technology's influence on pedagogy, faculty experienced a conflict between using technology and choosing pedagogical strategies. By examining this setting through activity theory, this framework was used to describe faculty members' experiences and to identify the conflict between technology and pedagogy. Activity theory connects the data in this instance to a

coherent story of faculty's experiences with the interaction between technology and pedagogy.

The last theme, community, occurred at two levels: course community and expanded community. Faculty members interacted within a community (course) as a process of achieving the object (shared course). However, they also interacted within an expanded community which included technical support staff and CITE leaders, whose shared object was innovative practices. Within the community, rules were negotiated to manage the administration of the shared course. Roles were also identified as levels of expertise in technology, policy, and practice became known in the community. Activity theory describes the interaction within and between the communities in this case. Community, rules, and roles are reflective of three elements in this framework.

All three themes interacted within this setting as faculty members experienced this shared course. Activity theory describes these interactions and practices and identifies emerging contradictions within this activity (Nardi, 1997; Wilson, et al., 2000). After examining activity theory, it provides a beneficial framework that connects the themes with the data collected in this study. It also provides meaning to the evidence collected and structures the story of the faculty members' experiences. Therefore, this framework is used to examine the interactions in this setting as well as to illustrate the relationships among the data pieces collected.

The following section describes the results, which are supported with contextual evidence lifted from the data. Contextual evidence portrays the rich description of the case study. Without this context, data are stripped or isolated from

the intentions of the faculty members' experiences, which lack meaning and understanding of the particular event being studied (Guba & Lincoln, 1998).

Results

The results are organized according to the themes with technology being presented first followed by pedagogy and community. Both levels of community are discussed with the first focusing on the interactions within the course. The other layer presents the expanded community that observed and supported the course. Each individual segment is structured with an introduction, John's voice, Jane's voice, and ends with a summary. A conclusion of the results section follows the last segment summary.

Technology

The course began on September 4, 1998, when the two classrooms were connected by using communication technologies. These technologies were gradually implemented and included telephone, electronic whiteboard, discussion postings, and video conferencing.

Within the first weeks, students and faculty members' voices were broadcast by an audio transmission through a full duplex conference telephone. Along with the phone, faculty demonstrated and displayed information by sharing data through electronic whiteboards. These whiteboards were connected by using Microsoft NetMeeting, free with Internet Explorer. NetMeeting allowed one site to share an application with another site. For example, faculty shared the course web page on

the first day simultaneously to both sites. The whiteboards were used in a similar manner as writing on a blackboard in a classroom, but in this case, the classrooms were approximately 1,500 miles apart.

The first discussion group posting was on September 6, 1998, by an UVa student. From this point to September 16, most of the postings dealt with technical problems and questions. The last technology component was added the first week of October. This component was close-to-full motion video, which was transmitted over Internet 2. Faculty members were able to see ISU students and vice versa. To make this connection possible, a special video card made by VCON was installed in Windows-based computers along with the accompanying software, Meeting Point. Internet-ready video cameras were used to capture the video, which was controlled with a remote control. The remote zoomed in and out, moved horizontally at least 180 degrees, and tilted vertically.

The following describes faculty members' experiences with technology.

John

John was the first instructor and taught from September 4 to October 23, 1998. His goal was to create a personable space for the students. However, with the conference phone, John stated, "I didn't feel a personal connection with people. It was hard to imagine what they were doing, saying, thinking." With his concerns, he had to figure out a method of inviting students into the conversations over the conference phone. Students and faculty felt awkward introducing themselves prior to speaking into the phone. John also found inviting the Iowa students into the

conversation difficult as the UVa students, in his physical presence, appeared to dominate the conversations.

John was not aware of the full capabilities of the electronic whiteboard, and, for this reason, used the whiteboard to transmit information. For example, readings were located on the Internet and shared simultaneously on both sites. The "just-in-time technology," as John referred to it, provided realistic context for the policy discussion.

Discussion postings were troublesome, because active interactions did not materialize in the same manner in the face-to-face classroom (Walker, 2004a). John did post a few prompts to remind the students to develop threaded discussions. For example, while at the beginning of the course, he posted a thread for the students to post their introductions. They did complete the introductions over a period of one week, but did not use the threaded heading. These postings were isolated 'hellos' by each individual student. John believed they did not know how to post; therefore, one of the UVa students presented information on discussion postings and threaded discussions. This had minor influences on the requested threaded discussions, because the actual postings emerged sporadically throughout the semester.

When the video was added in the fourth week, John was faced with a new dilemma of the self-conscious behavior emerging as students viewed themselves on the screen. Even though he had changed the classroom setup several times prior to video, he was concerned that the students became preoccupied by their on-line image. He first noticed when students were sitting away from the lens of the camera and avoiding "eye" contact with it. He decided to turn off the "home" picture on the

monitor; therefore, students were not able to see themselves but only the other site. However, this did not totally create a comfortable atmosphere for students to improve their discussions. Some believed it was difficult to discuss with the perceived picture from the other site.

With the novelty of the technology, frequent visitors came to the UVa classroom to observe the course. During this time, technology was constantly changing. As a result, John felt as if he were a guinea pig in a technology experimentation. These changes kept him unsure of what to expect the next class period. For example, John stated, "I would come in a few hours before class and somebody would say, 'Well, here's what we've changed,' and so then I'd have to make note of that and sort of figure out how to make it work for me in the contents of that day's class." This uncertainty, based on technology's unpredictable nature, was present to some degree throughout the course.

John tried to connect with all the students while coping with the technological changes and frequent visitors to the course. On the other hand, Jane was able to observe the first half to somewhat prepare her for the second half.

Jane

Jane taught from October 30, 1998, and ended teaching with the completion of the course on December 11, 1998. Jane felt lucky that she could observe John's exploration with the technology. By the time Jane taught, all the technical components had been implemented. Therefore, her view of the environment was not as disconnected parts as John's had been. Students, by this time, had begun to

adjust to the class structure. However, some students did not get used to the images on the screen. She professed an "internal excitement for teaching with the tools" as her day of teaching neared.

Jane had experience in using technology prior to this course even though she did not consider herself as technology savvy. She found it difficult to keep current in her knowledge of the ever-changing technologies. When she was asked to teach this course, she bought books, researched, asked questions; basically, tried to get as many materials on teaching with technology as possible. Jane stressed her desire to wanting to know more about technology and what its capabilities were. Her perspective on effective teaching overshadowed any concern she had in using technology. Her impression of teaching the first day was:

> It seems like it was like jumping into a river that was going downhill and it was rushing quite rapidly as I had to jump in and either rush with it and follow through and hit the bumps along the way or you know fall by the wayside. It just forced me into just jumping in. You know, I had no chance to think about whether I was gonna be able to ride the river or not. I just really had to just literally jump. There was no thought behind it. Just either you're gonna do it or you're not.

She felt the technology was not as overwhelming as it was intrusive in the learning environment. For example, when the image froze from the other site, for the first time, there were questions on what was happening, discussion on what caused it, and intervention by technical support. However, with more occurrences there were fewer questions on what to do. Faculty and students recognized the video was gone;

however, they continued with the discussion. Depending upon where the glitch occurred, they continued while the images were in limbo. As instruction persisted, in the background, technicians rebooted the system. The phone proved advantageous when the video froze, because there was still one stable connection with each other.

Even with technical glitches, Jane enjoyed the luxury of what the technology provided, which was sharing this graduate course. However, she stressed that new technologies needed to promote instruction and knowledge construction that otherwise was not possible.

In summary, this shared course was connected by communication technologies. However, initially, John was overwhelmed with the continued changes and novelty it portrayed to others. Jane had a different experience by teaching after the last component was added. Although Jane dealt with technical glitches, she believed the problems were offset by the possibilities the technology brought to the environment. Within technology-driven environments, the balance between technology and pedagogy was more in favor of technology at the beginning of the course than at the end. However, the pendulum was not stable even towards the end with frozen images and disconnected postings. The unpredictability of the technology still challenged pedagogical standards.

Pedagogy

Over a period of time, faculty members master pedagogical skills including preferred instructional strategies that vary according to instructional settings. Exercising these skills and being able to choose the appropriate one during a lesson

come with experience, similar to driving a car, become routine. When their instructional routines are changed or threatened, faculty members either seek new methods or rely on well-worn ones to get them through. The following describes faculty members' pedagogical experiences in this study.

John

Because John was the first to teach, he was not sure how technology influenced him pedagogically. His approach was to teach in a similar manner as his other courses. This method was basically lecture and discussions. He also believed he was not going "to get hung up on the technology." However, he began to rethink how to use technology to support other ways of teaching as the course progressed.

At first, the organization of the room was essential. John felt it was important to facilitate the physical and social needs of the students. He wanted to create one classroom where they were "speaking at the other site's video projection. . . like completing the other side of the table." By reorganizing the setup, John changed his approach to each technical component while becoming aware of his teaching practice. He stated:

> The technology seemed to change weekly. Some of this was by my design as instructor. In other words, I would teach the class and recognize that certain limitations hindered my ability to naturally teach the course. From my perspective, I was trying to make the technology seamless and invisible. During my portion of the course the classes were still fairly teacher-centered.

> As I was still struggling with basic teaching issues, and as I was learning the technology, I was using it in fairly conventional modes.

One strategy John implemented to promote discourse was to ask particular questions of the ISU students. He also encouraged all students to redirect their conversations to include both sites. However, technology was cumbersome as John initiated this strategy. It was new so he had to adjust his expectations of interaction between sites such as taking turns speaking via the conference phone. He hoped to include other opportunities to increase interaction such as using discussion postings. However, as noted previously, this was also a challenge.

To support the content, John found tremendous teaching resources by using National Public Radio audio clips, prime time television video clips of technology issues, *Washington Post* articles, and *Technology Counts* newspaper by Milken Exchange. He decided to take a chance and use these materials during class, but the students required more time to read and examine the material prior to discussion. Subsequently, the just-in-time technology (resources available on-line) did not correspond with what he wanted to accomplish. He determined the best method was to e-mail or post materials prior to class. This gave students time to examine the materials and to begin discussing it through the postings.

By meeting, e-mailing, and phoning each other, students did not view the discussion group postings as a primary source of communication. Because of these other sources, students did not post to increase discussions but posted to present their understanding of the content right before class. This led to numerous disconnected opportunities.

Although John was not as successful in implementing some strategies, he began to modify his teaching as "technology made him come sort of face-to-face with a couple of issues about the idea of using different resources of instruction." He did not realize how much he had to think about technology prior to teaching. However, this did not change the format or pedagogical strategies (lectures and discussions) of his other courses. This experience created more awareness for him of other modalities as well as experiencing this environment. John planned on rethinking how he wants to teach through technology and not teaching technology.

By watching Jane in the second half of the course, John was able to see these other modalities to engage learners.

Jane

Initially, Jane read literature on teaching with technology by ordering as many related books as possible. From this search, she looked for people's insight and experiences with technology, but she found that nobody was having an experience like she was having. She categorized her search as finding a lot on what technology was available, but little on the how-to or how to think with it. The literature lacked what the possibilities were. She decided, based on what information she found, to give the students the opportunity to think along with her. This conversation was more practical than theoretical.

Similar to John's initial philosophy, Jane also decided not to worry about the hardware and software, but focused on pedagogy. Pedagogy was an integral part of her approach to this course. She stated:

> If they don't have really good teaching sense, and they don't have strong command of their subject matter, and they don't have a strong pedagogy in terms of approaches, they're not gonna be effective with a new tool. We have to be able to use them in ways that we haven't thought of yet so that it helps to improve our teaching and improve our learning. Otherwise, why are we using them?

Technology within this setting needed to appear to be a natural part of her teaching. Without this understanding of technology's functions, she believed students were not focusing on the content and the ensuing discourse. By watching John as well in the first half of the course, she was better prepared for the continual disruptions and unexpected shut down of the equipment. From her observations, she learned what was possible with these tools. Jane reflected her:

> mind began racing with possibilities of how I would copy and paste student entries from the electronic discussion site on to the whiteboard and do the same thing with chunks of electronic readings. This way I could highlight and merge student thinking with the literature.

One particular strategy she used was to chunk the reading material and assign these chunks to students. In other words, her goal was to empower students to "develop expertise and articulate it in one form to another." For example, one of the assignments for the students was to read Rogers' *Diffusion of Innovation*. Jane divided the book into six parts, one for each student. Each student presented the material he/she was assigned and facilitated the discussion for that class period. This enabled the students to participate and to find links among the readings.

Because most of the glitches had been addressed previously, Jane found another use for the electronic whiteboard beyond sharing information. Fortunately by the time she taught, the technologies were performing more consistently. Therefore, she implemented more opportunities for the students to interact. For example, during the class period, Jane placed the students in small discussion groups. Students kept their group notes in Microsoft Word. When they presented their conversations, their Microsoft Word documents were shared over NetMeeting. All the documents presented were cut and pasted into one common document. The resulting document was used to instigate further discussions on policy in practice. This strategy permitted students to "share documents together and create documents together." Jane believed "we're learning how the tools are helping us to think or to critique together and to do collaboration together or to do a presentation in ways that we hadn't even thought possible before."

Through her research of materials and her experiences during this course, Jane stated, "there is not a replacement for a teacher who has command of the content to be taught," and technology's functions were to support the process of learning and teaching. With her excitement to try new things, she felt bruised by her experiences and at times her "uniqueness [could] get squeezed out like frosting from a tube, making me feel empty and discarded." From her reflections, technology raised the level of sophistication to the setting.

Her best suggestion for faculty contemplating using technology was to "consider the instructional/human considerations before, during, and at the conclusion of any class that utilizes multi-media technology to facilitate teaching and

learning." Although teaching with technology added "additional fibers to the fabric of instruction," its potential influence needed to be addressed in a very deliberate and knowing way if faculty members were going to optimize its potential. Faculty members who taught with technology were influencing the types of choices students considered.

In summary, pedagogy was approached differently according to when faculty taught. As noted previously, there were different experiences with the technology. At first technology was ever-changing which affected how John approached his teaching. He noticed students were also preoccupied with the technology resulting in a difficulty in sustaining conversations. By observing the first half, Jane was able to learn from the pitfalls of the technology. She believed she was fortunate to share with John his experience and was able to benefit from seeing the kinks being worked out of the technology. Both believed pedagogy as a vital part of the course; however, technology had the possibility to overshadow their pedagogical intentions while the novel idea was running haphazardly.

Community

Both faculty members believed the foundation for the course was the creation of a collaborative community, which was also stated in the course objectives. At times, they found it cumbersome to juggle instructional practice, content, technology, and active interaction to form a community. In a traditional classroom, faculty negotiated the rules with the students, which provided structure to the interactions as well as community development. In this study, community consisted of two levels

where one focused on course content and the other focused on the shared course (expanded).

Below are descriptions of these two levels based on faculty members' experiences in developing and participating in a community.

John: Course community

This shared course with its uniqueness of using communication technologies was a novelty; therefore, more visitors came in the first half of the semester to observe. The interruptions proved to be a concern in the development of a cohesive community as it appeared to be a start and stop motion when faculty and students tried to converse.

John was worried about remaining sensitive to the needs of his students and reaching them through various learning modalities as he began to plan for the course's policy section. He was also unsure of what to expect from the actual use of the technology and felt he was "kind of the guinea pig." Although he wanted to create a positive and open environment, John found it difficult to get past the instructional concerns that emerged as technology was gradually implemented. John's approach to address his concern in developing a community was to support and improve the discussions in the postings. John stated:

> The way I approach group communication is I throw out an idea and it belongs to the group and I relinquish some personal attachment to it. It's the talking stick model of some Native American cultures. However I

acknowledge that some feel some risk when communicating electronically.

What can we do to reduce the risk and promote discussion?

For example, John attached a draft paper to a posting for the students to critique. He admitted to the group that the paper was rather "drafty" and trusted that they would be kind. John felt this was an opportunity to share an approach to change instruction together with the students. Unfortunately, students did not take the invitation to engage in a more critical and reflective discussion, because there were no postings referring to students undertaking the invitation of critiquing his paper.

Up to this point, discussions centered more on understanding of content by personalizing what students read and shared, such as information and resources. Some social negotiation emerged as students waded through the content, but with the first four weeks of John's teaching, technology was still a focus of concern. As students became comfortable with technology, they began to discuss topics related to the content, interacted with other students at the other site, questioned what they were reading, supported each other in content as well as with technology, and actively negotiated the final project topic. John noticed a slow materialization of a community as Jane started to teach.

Jane supported this fledgling community by encouraging collaboration. One of her first goals was to have students refer to others by using their names whenever possible. This method was to provide them with a sense of belonging in the group.

Jane: Course community

Jane viewed technology as another tool that supported the creation of an interactive environment. This allowed students and faculty to interact in ways that were not otherwise possible. For example, in order to collaborate on the final project, students needed a purpose and a means to collaborate. Therefore, Jane encouraged students to use the postings to think together. From these postings, students shared a vision of the final project structure. By discussing the intention of policy, students were able to develop research questions to guide the final project. Although their discussions were more interactive than in previous weeks, the postings were not as reflective of the actual discussions during class. Classroom discussions were more active.

UVa students did use the postings to plan, delegate, and to critique their research on technology policy in Virginia. However, ISU students did not use the discussion postings for their final project, but met before and after class to discuss the development of their project into a web page. The intention was to have these two projects be combined into one; however, this did not materialize by the end of the course. Jane attempted to prompt students in the postings to personalize the project and to collaborate more in the planning stages. With more time, students may have shared their visions as one project.

In order to establish and sustain collaborative efforts, the community development needed ongoing faculty support. In addition, "developing community among class members is as important for scaffolding learning as it is for accomplishing goals for inclusion." Although she was not successful in the students

collaborating on one culminating project, she suggested more scaffolding for this goal. Therefore, during the introductions and course overview, faculty members needed to be explicit in their learning expectations, including collaboration and reflection.

Although faculty focused on community within the course (students and faculty), they also participated in an expanded community as a result of the uniqueness of sharing graduate courses. John and Jane articulated their reliance on technical support staff as their lifeline in being able to function within this technology-driven environment.

Expanded community

At first, John did not feel comfortable with the technology and relied on technical support for the technology setup. He recalled that it was not second nature to him to juggle separate components (audio, whiteboards, and video) with the additional concern of teaching.

For both, the actual setup proved to be another obstacle. In a brick and mortar classroom, most of the time, they did not rely on others to teach. If they continued this practice in this setting, faculty members required to plan for an hour to set up the technology and to connect to the other site. This procedure assumed the classroom was empty at that time. This was not an expectation for the faculty; therefore, technical support staff prepared the setting for instruction. Faculty received some training on how to use the equipment. However, by having technical support staff; faculty considered them as "technology lifeline." By observing the

technical staff, faculty believed the best training was asking questions and receiving hands-on practice with the equipment.

In summary, faculty members were supported by an expanded community and used community building strategies to enhance learning as well as construct active interaction among students. This interaction and the collaborative project provided building blocks for community development (Walker, 2004a). This proved to be cumbersome at times, but both mistakes and successes enabled them to learn what the possibilities were.

The expanded community created a safer foundation for faculty to risk failure. Conversations among this community enabled both to explore technology-driven environments from both instructional and technical perspectives. Faculty discovered more on technology's capabilities while technical support staff learned more on pedagogical strategies. Jane believed there must be a "harmonious relationship between technical staff and instructors" to enhance the success of distance education.

From their experiences, faculty members reflected on what was possible during this course. For Jane, this experience taught her distance education was a "doing" possibility where students actively communicated and interacted with each other. Although faculty members saw themselves teaching with technology, they did not know what that really meant and believed finding the answer was a continuous journey.

The following discussion focuses on my reflections based on their experiences and my search for understanding and meaning in this process.

Discussion

For this course, faculty members' intentions were described as an opportunity to create a learning space for an on-line collaborative community to discuss policy and practice of diffusion of technology. This learning space was formed by using communication technologies to enhance interactions among doctoral students and faculty members. The results section presented faculty members' experiences in this space. Their experiences ranged from challenges to the unfamiliar but ever-changing technology to the possibilities of an on-line community. From the surface, challenges were alleviated by offering faculty more professional development activities, and possibilities materialized with more incentives. However, sustaining change in this setting required a deeper understanding.

Pedagogy in technology-driven environments has reflected the lecture method of efficiency conveying knowledge from faculty to students (Palloff & Pratt, 1999). This method of transmitting has continued although technology has changed dramatically from instructional television to real-time conferencing (Kearsley, 2000). Transmission pedagogy and communication technologies are contradictory where the former supports one-to-many interaction and the later creates many-to-many interactions (Paulson, 1995). This foundation in distance education forms tensions between what is currently practiced and what are the possibilities (Marra & Jonassen, 2001).

These tensions form contradictions in the setting that either motivate for further development or hinder progress. By using activity theory, contradictions are identified to better understand the dynamic environment. The purpose is not to

predict but to describe interactions and identify ensuing imbalance within the activity (Kuutti, 1997; Nardi, 1997). Contradictions are identified by four levels: (1) primary, (2) secondary, (3) tertiary, and (4) quaternary. Primary occurs within an element while secondary takes place between elements. The third level, tertiary, is between the object of one activity with another object of a culturally advanced activity. The last level, quaternary, happens between activity systems (Il'enkov, 1977; Turner, et al., 2001).

This imbalance also occurs within a hierarchy of three levels: operation, action, and activity. For example, John experienced a challenge in encouraging students to use the discussion group postings for discourse. The students posted disconnected information and used the class period to engage in discussions. This imbalance was identified as a primary contradiction where it occurred between two tools. These tools functioned to routinely support communication among students. Students shared information by posting text at any time any where while they negotiated meaning during a set time period once a week through real-time conferencing. Table 7 demonstrates additional identified contradictions.

The table has been created by examining the hierarchical structure of an activity within this setting and relating these layers with the themes as presented in methodology and results sections. By placing them within this matrix, these layers have been identified in parentheses. The layered structure illustrates the dynamic nature of an activity where it is in constant construction and negotiation among the elements at varying stages of their development (Leont'ev, 1981). Operation is routine conditions generally carried out automatically by a machine, which is an

efficient function of technology (Kuutti, 1997). Action is communicating goals by individuals or groups, such as using learner-centered pedagogy to create on-line communities. An object or motive, which is carried out by a community, is enabled by within an activity. The following describes the identified contradictions, illustrated in Table 7.

Table 7. Contradictions.

Themes	Operation	Action	Activity
Technology	Real-time conferencing and Discussion Group Postings (1)	Sharing video and Ignoring images (2)	Faculty's struggle between pedagogy and technology (2)
Pedagogy	Lectures and Discussions (1)	Isolation of learners and On-line Community (2)	
Community: Course Content	Identifying your name prior to speaking on conference phone (2)	Sharing class periods with visitors observing course/ technology (4)	Learning course content or technology (2)
Community: Sharing Course	Changing conference phone to become compatible (3)	Enrolling in course with transcripts showing independent study credit (4)	Faculty's pedagogy/ Technical Staff's technology (2)

Within the technology theme, faculty struggled between technology and its influences on pedagogy. This is represented with the interactions between the mediational tool (technology) and another level of tool (pedagogy). For example, Jane intended to have students critically examine each sites' final project by sharing insights, suggestions, and comments through discussion postings. Because the postings were not as successful, this strategy did not materialize at the end of the course. Two final projects were presented instead of one negotiated project (rules). By using activity theory, the interactions between the two tools were described along

with the overlaying interactions between faculty and students. These interactions are described as faculty (subject) and students (course community) interacting within this setting while faculty select pedagogical strategies (tools) to enhance this technology-driven (tools) course (object).

Technology also provided a challenge for faculty when the video was introduced. Video enabled each site to view the other; however, it also presented a dilemma for students. Some students tried to avoid their image by turning away from the camera, which also removed their image from others. Although John attempted to adjust the physical layout, he was not as successful in creating the illusion of one classroom. The connections within this example were identified by using activity theory. The video's function (tool) was to join the participants in the two classrooms (community). John (subject) arranged the UVa classroom as part of his classroom practice (pedagogy). In summary, technology theme was further clarified by using activity theory. This framework illustrated technology's influences on pedagogy as well as the other elements. Faculty experienced the unfamiliar technology in the beginning. This unfamiliarity led John to resort to using familiar pedagogical strategies such as lectures.

Within pedagogy theme, John and Jane proclaimed their desire to ignore the technology and to provide opportunity for a community to grow. Because of the initial disruptions by the unfamiliar technology, John was faced with how to teach in this chaotic setting. He wanted to include the Iowa students in the conversations; however, the physical proximity of the UVa students created isolated conversations on one site with onlookers from the other. This was due to another contradiction

developing between which pedagogical strategy, lecture or discussion, to use. Although John and Jane implemented small groups, at times, lecture emerged as a well-worn tool whenever there was a disruption in technology such as frozen images. In summary, there was an interaction between two tools: pedagogy and technology. Faculty members (subjects) intended to use technology (tool) as a delivery tool to reach students from both sites (community). Faculty, in this case, needed to work through the technology prior to selecting pedagogy to enhance a collaborative community. In other words, faculty needed to find a balance between creating a technology-enhanced shared course and a pedagogically sound course (object) prior to using student-centered learning.

Within course community theme, faculty (subject) and students (community) were unsure of how to participate in discussions (pedagogy) when their task was to introduce themselves prior to speaking into the conference phone (tool). This technology hindered interaction and led to varying rules of when and how to interrupt discussions. The learning space was also challenged when visitors attended class to observe the technology in action. John felt like a guinea pig where learning stood still while another event came into this setting. John and Jane also described their concern of whether or not the object was to learn the course content or did the actual technology become the focal point of instruction (substitute object). Technology, as a substitute object, appeared to become both the tool used and the object that was trying to be achieved. In essence, the technology was perpetuating its own growth. By using activity theory, technology as a substitute object was clarified as the course community struggled within this setting. This concern was

also prevalent within the expanded community. The flexibility of communication technologies can increase the level of sophistication of the learning environment. However, in this case, the flexibility was hidden behind the initial challenges of using unfamiliar technologies.

Within the expanded community theme, faculty and technical support staff discussed technology's function within this setting and value of using pedagogical strategies to drive teaching and learning. The novelty of the technology contradicted the attempts by faculty to create a learning space. In the beginning, John felt it was difficult to keep ahead of the technological changes. While at the end of the course, Jane found it a challenge to bring the critical examination of content expected in a doctoral course back to the forefront. There was a trade off between technology and pedagogy depending upon how well the technology was performing at that time. This change over the course of the semester was made clear through the activity theory lens. The conflict between technology and pedagogy was altered as faculty (subject) and students (community) became familiar with the technology. This enabled pedagogy to become the process of facilitating the achievement of the activity (shared object or building community).

Other contradictions included the Registrar Office unable to change policy in recording courses on students' transcripts. Registrar's objective to administer transcripts did not reflect the nature of the shared course on students' records. ISU's equipment purchases were also influenced by UVa's global expertise. For example, ISU began using a speakerphone while UVa began with a duplex conference phone. ISU decided to change their phone to capitalize on its capabilities and to conform to

UVa's equipment. Within the first week the phones were the same brand and model; however, this switch did not change the lack of active discourse.

In summary, during their experiences, faculty members experienced the possibility of sharing a graduate course; however, encountered challenges to their instructional practice within this technology-driven environment. For faculty, selecting pedagogical strategies was a central tenet to their teaching. When their strategies were not successful, they both reflected on how they addressed this contradiction between their expectations and the setting. Although John began to examine his practice, he resorted to using lectures and discussions in order to keep ahead of the technology. Within distance education settings, faculty relied on transmission pedagogy to balance the chaotic environment (Palloff & Pratt, 1999; Parker, 1999). Jane noted creating the possibility, such as this setting, sometimes outweighed the unplanned contradictions. Faculty members' experiences were influenced by multiple perspectives that were enhanced by this framework. Instead of isolating on John's or Jane's perspectives, the community members were an integral element in the dynamic setting. Within this setting, the interactions between faculty and the community included negotiated rules, shared levels of expertise, and repeated struggle between technology and pedagogy. By using activity theory to connect the data among the themes, the story emerges from the interactions and contradictions within the activity.

From this study, nuggets of faculty's experiences emerged from the data. One of the nuggets was faculty choosing to use familiar pedagogical strategies, such as lectures, when they were faced with unfamiliar communication technologies at the

beginning of the course. Another related nugget was that student-centered learning emerged when there was a balance between technology use and pedagogical strategies. When faculty members' comfort level with the technologies increased, their pedagogical choices also expanded to include more learner-centered pedagogy. By balancing technology with pedagogy, the learning environment changed during the course as the focus emerged on creating a student-centered learning space. The third nugget was technology's flexibility in this environment increased the level of sophistication; however, this flexibility surfaced after the technology became familiar to faculty. The last nugget was faculty's inclusion in another level of community. Faculty members focused on developing the course community while experiencing a new expanded community. In this case, faculty felt this community provided a lifeline to their survival in this technology-driven environment. They evaluated their perceptions of an isolated classroom as they opened this virtual shared course to additional members with the increased use of communication technologies.

Conclusion

With increased technology use, classroom walls are being redefined. Unlike previous technologies (radio and television), the Internet supports a higher degree of social interaction. Although technology is rapidly changing, pedagogy within distance education settings is still practiced by transmitting knowledge from faculty to students. With communication technologies, learner-centered pedagogy creates the

possibility of on-line communities. These communities are actively engaged in socially negotiated contextual discourse.

To transform faculty members' practice, conditions for change create the possibility to enhance sustainability. To understand these conditions, I have proposed activity theory as a description tool to examine interaction within dynamic and complex educational settings and to identify emerging contradictions. With this understanding and awareness, it is possible to balance the setting by using technology to mediate the achievement of the object, such as learning objectives.

This study explored faculty members' experiences within a technology-driven environment. Their journey opened the door to examining their current practice and their interactions with technology settings and community. With their experiences, faculty members began to understand pedagogy through a new set of glasses by using technology to mediate learning and teaching activity. This mediation encompasses embracing technology as a social and historical tool within a complex environment that is in continual movement. Without a deeper understanding of this movement including influential interactions, conditions for change become difficult to sustain.

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CONSTRUCTING AN ON-LINE COLLABORATIVE COMMUNITY: LISTENING TO STUDENTS' VOICES

A paper to be submitted to the *Educational Technology Research and Development*

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Introduction

Teaching and learning practices have slowly been challenged as distance education has increased its presence in educational technology graduate programs (Archer, Garrison, Anderson, 1999; Armstrong, 2000). Faculty members are realizing current communication technologies (e.g., e-mail, threaded discussions, real-time conferencing, and groupware) are capable of supporting different teaching practices. These practices move beyond delivering instruction to mediating interactions within an educational setting (Bonk & Cunningham, 1998). However, some faculty members appear to be slow in adjusting their pedagogical strategies to enhance students' learning within this setting (Cuban, 2001; Means, 1994).

Previous expectations of autonomous and isolated study have also been challenged as technology evolves from print-based correspondence studies to Internet-based real-time conferencing (Garrison, 1990). A more student-centered approach to learning is emerging in contemporary distance education (Kearsley, 2000; Palloff & Pratt, 1999). This approach focuses on students actively engaging

and negotiating knowledge construction within a community of learners (Bransford, Brown, & Cocking, 1999; Bonk & King, 1998). However, there is little data describing the process of changing teaching and learning practices in distance education and what conditions sustain these changes (Garrison, Anderson, & Archer, 2000; Marra & Jonassen, 2001).

The purpose of this paper is to present benefits and consequences from students' perspectives as two geographically separated educational technology graduate programs share a doctoral-level course. This course is based on an innovative collaboration to connect two virtual classrooms through communication technologies. Questions to be addressed are "How do students view and construct an on-line collaborative community? What does this community look like? How does technology mediate the formulation of the community?" Students' voices are often silent in the design of instruction; therefore, their voices provide valuable information to help designers in the creation of on-line collaborative communities (Hara, 2000).

This paper begins with an overview of literature on constructing community within a distance education setting. After this literature review, the research methodology is presented. Next, results of the students' voices are described followed by a discussion of those results. Finally, a conclusion closes the paper and emphasizes the benefits and consequences of constructing an on-line collaborative community.

Constructing On-line Collaborative Community

Educational technology graduate programs are in transition as they enhance their marketability for diverse students, respond to demands from society, and juggle increased technology use (Armstrong, 2000; Miltiadou & McIsacc, 2000; Mory, Gambill, & Browning, 1998). To address this transition, at a classroom level, some faculty members are using communication technologies to deliver on-line courses and to enhance traditional on-campus classes (Palloff & Pratt, 1999). However, there appears to be a gap between instructional practice and technical capabilities (Cuban, 2001; Walker, 2004b). Some explanations for this gap are the increased level of technical competency faculty need to keep ahead of progressively more complex technology and administrative pressures to use distance education to raise student enrollment (Marra & Jonassen, 2001). With ever-changing technology, faculty members experience insufficient time to learn and practice new strategies; therefore, they choose to use a transmission mode for teaching with unfamiliar technologies.

While programs transition toward distance technology teaching and faculty explore technology use, an untapped resource, students' voices, has emerged as a viable member in this setting (Hara, 2000). Traditionally, students have participated in course design through evaluations; however, their roles have transformed as technology supports more interactive learning (Hara, 2000: Marra & Jonassen, 2001). Hence, students are actively learning within virtual environments, which have been passively directed by instruction (Jonassen, Peck, & Wilson, 1999).

On-line learning

Historically, higher education, in particular extension programs, has used technology to reach students. In the 1800's, printed textbooks supported correspondence studies (Brown & Brown, 1994). Today, powerful digital environments are established on the Internet, which is capable of transferring large amounts of audio, video, and data at high speeds (Hara, 2000; Harasim, Hiltz, Teles, & Turoff, 1996; Kearsley, 2000). Students have access to multi-sensory experiences beyond the printed text with the use of the Internet (Dede, 1996).

Students elect to enroll in on-line courses to get access to experts and subjects not conveniently available to them. This has been increasingly popular at the graduate level (Kearsley, 2000; Moore & Kearsley, 1996). However, some students are not prepared for this new learning environment and this leads to high attrition and dropout rates in on-line courses (Hara, 2000). Students' frustration at learning to learn at a distance emerges from their insufficient knowledge of technology; lack of convenient access to equipment; confusion of expected social communication; or their inability to manage time (Hara, 2000; Grubb & Hines, 2000; Miltiadou & McIsacc, 2000). Students also experience a sense of isolation from faculty and others and spend too much time learning technology and not the content (Hara, 2000; Palloff & Pratt, 1999). For example, in an on-campus class, students expect to meet faculty face-to-face and to obtain immediate feedback. Taking courses on-line, they interact with faculty through the technology where feedback comes in hours rather than seconds. With slow feedback, students feel isolated from faculty, which result in them dropping the course.

To address these issues, some faculty members diminish students' feelings of isolation by choosing pedagogy that encourages active interaction within a community of learners (Miltiadou & McIsacc, 2000; Mory, et al., 1998). An alternative to transmission pedagogy is learner-centered pedagogy (Hemming, 1999; Walker, 2004b). Learner-centered pedagogy is engaging learners in knowledge construction through collaborative activities where learning is embedded in meaningful context (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Community development is at the heart of this pedagogy (Geer, 2000; Hemming, 1999). By developing communities, students have opportunities to share knowledge, negotiate meaning, and apply their mutual understanding within contextual settings (Bransford, et. al., 1999). By connecting technology's interactivity with learner-centered pedagogy, faculty members enhance interactions among students (Bonk & King, 1998).

For example, students communicate with each other by asking questions or sharing ideas. By communicating, they clarify what is familiar and what is not. This clarification prepares them to collaborate on particular tasks, such as project-based activities. This collaboration with an identified group lifts students to another level of social interaction, community. Community is the supporting structure for establishing social interaction through communication technologies. Hence, students progress through communication and collaboration prior to establishing a community of learners (Siegel & Kirkley, 1998).

Collaboration and community need to be defined for the purposes of this research. The following section defines these concepts and is followed by a summary.

Collaboration

According to current research, collaboration and cooperation are different concepts (Geer, 2000; Lewis, 2000). Cooperation is the process of students agreeing to work together in order for each individual to attain separate goals (Bernard, Rubalcava, & St-Pierre, 2000; Geer, 2000). For example, as part of a diffusion course, students develop a presentation on the relative advantage of distance education technologies in the last five years. A cooperative approach to this task is to divide it into smaller parts. This is accomplished by delegating to each student parts according to an identified characteristic or by drawing straws (Geer, 2000). Each has the responsibility and understanding for that assigned section. The final product is a collection of each individual's work.

In collaboration, the emphasis is on the joint commitment of the whole group to achieve a shared goal (Bernard, et al., 2000; Lewis, 2000). The group also decides, thinks together, and combines "independent conceptual schemes to create original frameworks" (John-Steiner, Weber, & Minnis, 1998, p.776). The task is divided among students; however, the discussion is based on levels of expertise. Experts and novices share their understandings and negotiate a mutual understanding that represents the whole group. In completing this task, students share their perception on the concept, negotiate the process of completing the task, question positions, and commit to this joint endeavor. Unlike the cooperative model, collaborators present a mutual document that represents the workings of the whole group. Collaboration forms a foundation for the existence of a community (Wenger, 1999).

Community

Community is an informal group bound together by shared goals, collective expertise, and mutual interdependence (Wenger, 1999). These informal groups have been referred to as communities of practice. Communities of practice are living experiences of shared meaning among group members within learning environments (Wenger, 1999). Group members are also continually moving in and out of the community as goals are completed or changed. This movement, subtle or chaotic, alters the identity of the community (Wenger, 1999).

Community appears to be rooted to its physical location; however, in distance education time and place are defined virtually (Palloff & Pratt, 1999). The location, physical or virtual, does not characterize the formation of a community (Hung & Chen, 2001). However, this formation is enhanced by setting the conditions for it to flourish (Wenger, 1999). These conditions are formed within the community where students identify with shared goals and outcomes (Hung & Chen, 2001). Some education groups have defined these outcomes within virtual environments as (Palloff & Pratt, 1999):

- Active interaction involving both course content and personal communication,
- Collaborative learning evidenced by comments directed primarily from student to student rather than student to instructor,
- Socially constructed meaning evidenced by agreement or questioning, with intent to achieve agreement on issues of meaning,
- Sharing of resources among students,

- Expressions of support and encouragement exchanged between students, as well as willingness to critically evaluate the work of others (p. 32).

Other education groups have identified core elements that actively interact within a community (Garrison, et al., 2000). These core elements are cognitive presence, social presence, and teaching presence (Garrison, et al., 2000). For cognitive presence, a community constructs meaning through sustained communication such as sharing information and connecting ideas. Within this community, members establish themselves as "real people" by expressing emotions or encouraging collaboration (Garrison, et al., 2000, p. 94). This is social presence. The last core element is teaching presence, which is the design and facilitation of the educational experience. Some teaching presence indicators are initiating discussions and sharing understanding (Garrison, et al., 2000).

By comparing the outcomes listed above and these core elements, community is an active interaction of socially established members who collaboratively construct meaning, share information, connect ideas, and express emotions (Garrison, et al., 2000; Palloff & Pratt, 1999). This community also communicates by spoken words or text within this virtual environment. For example, real-time conferencing supports use of oral communication where students experience gestures, tone of voice, and facial expressions (Garrison, et al., 2000). They use audio and video to spontaneously discuss topics at a faster pace.

Within text-based communication, such as discussion groups, students lack visual cues. However, they have opportunities to reflect prior to engaging in critical discourse (Palloff & Pratt, 1999; Wegerif, 1998). For example, students post their

understanding of course material. As they read other postings, they begin to clarify by asking questions and posing alternative ways for understanding a concept. Students continue communicating by sharing related books and supporting each other's discovery of new material. As they become comfortable within the group, students collaborate on an assigned project. They become comfortable in this setting by sharing humor, self-disclosing personal information, and using emoticons (Rourke, Anderson, Garrison, & Archer, 2001). This progression of building communication and collaboration develops a foundation for community to grow (Siegel & Kirkley, 1998).

In summary, teaching and learning practices are challenged with increased use of communication technologies within distance education. Faculty members are addressing this unfamiliar technology by slowly changing from teacher-directed instruction to student-centered learning. This has also shifted their pedagogical choices from transmission to learner-centered pedagogy. By using learner-centered pedagogy, students create on-line collaborative communities. These communities communicate and perform activities that give emphasis to equitable interaction, shared goals, mutual resources, and social negotiation of meaning (Hung & Chen, 2001). During this process, community members construct knowledge while experiencing their identity (Wenger, 1999).

Community members are also motivated to work together to achieve a goal or object within an educational activity. When this activity is supported by communication technologies, members' active interactions lead to complex interrelationships within a chaotic environment. A tool to understand and to sustain

these communities is activity theory (Hung & Chen, 2001). This framework describes dynamic interactions among elements of an educational activity and identifies emerging conflicts resulting from these interactions (Kuutti, 1997). By identifying these conflicts, activity theory provides another level of analysis for data collected from the community's activities. Activity theory is described in the following section.

Activity Theory

Activity theory describes the social interdependency of the community achieving shared goals (subject, community, and object) within a mediated infrastructure (tools, rules, and division of labor) (Hung & Chen, 2001). Figure 1 represents a graphical illustration of this framework (Cole & Engeström, 1991). The elements (subject, community, and object) present dimensions of interactions at individual and social levels, which in Figure 1 is the central triangle (Hung, Koh, & Chua, 2000; Walker, 2004c). This learning community also uses tools to communicate, rules to guide this communication, and roles to create a unique culture (Bellamy, 1997; Wenger, 1999). Tools, rules, and roles are the mediating elements in activity theory. These mediating elements carry sociocultural history between subjects and the activity's contextual setting.

For example, students (subject) within a distance education course are achieving a learning objective on the intentions of policy development (object). They are connected through real-time conferencing (tools). During one session, students discuss their shared understanding of this concept with faculty members and technical support staff (community). Prior to this discussion, guidelines were

negotiated of how to interact with others in the group (rules). Within this community (students, faculty, and technical support staff), there are varying levels of expertise on policy development (roles). Through their conversations and interactions, the community share meanings of intentions. By the end of the session, an expert definition has been redefined into a personable and meaningful one that is shared by the group (object).

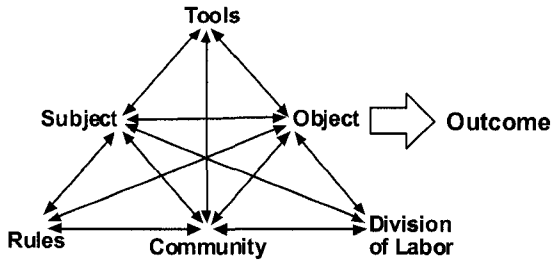

Figure 1. Activity structure (Cole & Engeström, 1991).

However, activities do not exist in isolation. Activities interact with at least two other activity structures that form activity systems (see Figure 2) (Center for Activity Theory and Developmental Work Research, 1998). Within these systems, activities are distinguished from other activities by the goal (object) that is being achieved (Kuutti, 1997). In the above example, defining intention (object) becomes the guidelines for policy development (rules) in another activity. The interaction between two activities moved the object of one activity to the rules of another. The dynamic nature of this system reflects some of the chaos in a technology-driven environment (Walker, 2004c).

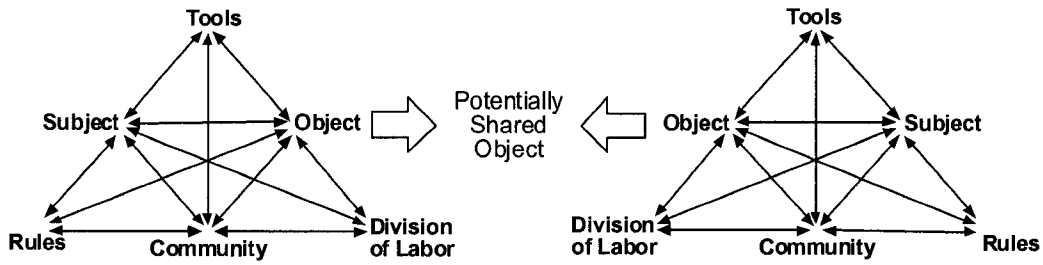

Figure 2. Activity systems (Cole & Engeström, 1991).

Along with interactions between elements, an activity is layered with supporting actions and operations. These layers create dynamic movement within the contextual setting (Kuutti, 1997; Leont'ev, 1981). Within an activity, there are actions and operations that support the achievement of the object. From the above example, students have shared their notes for defining intention through an electronic whiteboard. The community carries out the object of the activity, which is the intention definition. An individual or a group carries out the goal of the action. In this case, an action is the discussion strategy. The operations are the conditions that are routine. The community shares the notes by routinely switching the video camera from viewing the electronic whiteboard back to the visual of the participants.

Activity theory describes contextual settings within an activity and among other systems. It also identifies conflicts that emerge from these interactions. These conflicts have been organized into four levels of contradictions: (1) primary, (2) secondary, (3) tertiary, and (4) quaternary (Il'enkov, 1977; Turner, Turner, & Horton, 2001). Contradictions are sources of development and emerge from interactions within an activity and between activity systems (Kuutti, 1997). The following table (Table 1) provides an overview of these levels.

Table 1. Levels of contradictions.

Levels of Contradiction	Description	Example
Primary	Inner contradiction within elements	Conflicting tools that support communication: discussion postings and real-time conferencing
Secondary	Between elements	Conflict between object and tools: collaborative learning and discussion postings
Tertiary	Between object/motive of one activity with the object/motive of a culturally advance activity	Conflict between tools (electronic whiteboard) used for a shared course between two educational technology graduate programs
Quaternary	Between an activity and its neighboring activities	Conflict between Class A continuing its session while Class B waits in the hallway.

For example, a primary contradiction is the imbalance between students not using discussion groups to discuss concepts when they prefer to use real-time conferencing. Both tools support communication; however, students are actively interacting when using video and audio but do not respond to postings. This can further develop into a secondary contradiction as students are challenged to learn content as they are simultaneously trying to use technology. Students are frustrated as they attempt to discover how to use discussion groups while learning unfamiliar material. A tertiary contradiction is between a technically advanced program and another program not as advanced. These programs are sharing a course and jointly choosing equipment to connect the classrooms. The technically advanced program purchases an electronic whiteboard from a local vendor. The other program, who is not as technically advanced, cannot buy this brand from its local vendors and

university policy does not permit purchasing equipment from out of state vendors. The technically advanced program challenges policies of the other program. The last contradiction, quaternary, is the conflict between two classes. Class A is consistently late in completing its session in the distance education room. Class B waits in the hallway for its session to begin. However, Class B does not receive the allotted time, because Class A runs into Class B's session time (Walker, 2004b).

In summary, with increased use of communication technologies, students are experiencing on-line courses as active learners within a community. This is different to previous experiences of isolated individuals passively learning from faculty's teacher-directed instruction. These new distance education courses are challenging students' expected learning practices. By describing students' experiences, faculty members may choose better methods to sustain learning within a community. Activity theory was presented as a framework to describe interaction within the distance education course studied and to identify emerging conflicts.

Prior to presenting results, the research methodology is described. The methodology section is organized with the setting presented first, followed by a description of the subjects. Next, detailed methods on data collection are provided. After the data are described, the methods of data analysis are presented. This section closes with a summary.

Research Methodology

By using case study methodology, students' voices are presented with a thick and rich description of their experiences (Geertz, 1973; Van Manen, 1990). Case

study is a detailed examination of a complex, contextual setting where the researcher presents, in this case, students' understanding of their setting (Stake, 1995). The researcher also observes interactions within context, describes complexity of the setting, and notes atypical instances (Stake, 1995). There is also a participatory relationship between the participants and the researcher (Stake, 1995).

In this study, each student narrates his/her own perspective on the shared graduate course. These perspectives are fragmented pieces of information that by themselves do not tell the whole story. The conflicts and understandings of the complete story reflect joining these multiple perspectives into one narrative. This method of layering their stories brings together unique viewpoints (students) to portray a rich observation of a common event (Ely, Vinz, Downing, & Anzul, 1997). In essence, the event (shared course) is constructed by actors (students) narrating their stories (experiences). The whole play portrays their understanding and emerging conflicts within this event. The once disjointed picture comes into view as each story is layered with rich descriptions (Ely, et al., 1997). This case study presents students' voices as layered stories that have been joined to complete a narrative from multiple perspectives.

The case study was guided by research inquiries asking "How do students form an on-line collaborative learning community?" "What are the consequences to the cultural tools and practices as this shared course is made possible by using communication technologies?" These consequences have not been properly addressed within technology-driven environments (Rogers, 1995). By describing students' experiences in this setting, faculty and technical support staff have a better

understanding of how to balance technology and pedagogy to create a learning space for their students. Therefore, a case study method addresses the effects of adoption, such as communication technologies (Rogers, 1995; Willis, Thompson, & Sadera; 1999).

Another analysis tool for case study methodology is activity theory (Vygotsky, 1978). As a descriptive tool, this framework describes the setting and identifies contradictions. Similar to layered stories, activity theory presents multiple perspectives (individuals and community) of a particular setting (activity). The interactions within this setting emerge as individuals and the community struggle to obtain the object (learning objective) of an activity (shared course). The multiple perspectives (individuals and community) do not tell the whole narrative until the story is conveyed from an activity level.

At this level, the whole setting is described from joining all perspectives and identifying the conflicts from the interactions within the activity (see Table 2).

Table 2. Connections between activity theory and community.

Activity Theory (Kuutti, 1997)	**Factors** (Hung & Chen, 2001)	**Community Outcomes** (Palloff & Pratt, 1999)
Subject	Interdependence	Sharing
Community		Interaction
Object		Collaborative
Tools	Infrastructure	Structure
Rules		Meaning
Roles		Support

In particular, this study examines students' experiences in taking a shared doctoral-level course between two geographically separated educational technology graduate

programs. Students (subject) interact with others in the course (community) as they communicate guidelines on collaborating (rules). Through this process, students perform certain roles such as helping others set their preferences for the news group (roles). Table 2 illustrates a relationship between activity theory and literature presented previously on identified factors in a setting and community outcomes. Activity theory presents a different lens to examine a technology-driven environment in educational technology graduate. This framework is used to describe and to identify conflicts, contradictions, or consequences from the dynamic interaction within the setting.

Setting

The course studied in this research emerged from the collaboration between the Curry Center for Technology and Teacher Education at the University of Virginia (UVa) and the Center for Technology for Learning and Teaching (CTLT) at Iowa State University (ISU). These centers formalized their on-going collaboration by forming the 'Coalition for Innovation in Teacher Education' (CITE). The overall goal was to identify innovative methods to better prepare pre-service teachers (Coalition for Innovation in Teacher Education, 2000, p. 1). The first activity was sharing graduate courses, which began in 1998-1999 with four pilot courses. One of those courses offered by UVa, *Diffusion of Educational Technology: Policy and Practice,* was the foundation for this case study. The following table (Table 3) provides a timeline of notable events in creation and implementation of this course.

Table 3. Timeline of notable events.

Date	Event
04/1998	CITE Leaders met at ISU to begin collaboration.
04/1998	Author wrote internal ISU grant to purchase equipment.
05/1998 – 08/1998	UVa received internal money from IMPACT initiative.
05/1998 – 08/1998	Each program researched equipment purchases according to their respective university procedures and available vendors.
08/1998	UVa purchased most of their equipment.
07/1998 – 09/1998	ISU obtained equipment.
07/1998 – 09/1998	Technical support practiced connecting sites.
09/07/1998 – 12/17/1998	Class in session for *Diffusion of Educational Technology.*
09/07/1998	Started with electronic whiteboard & phone.
09/14/1998	Discussion groups added. Changed phones at ISU to be compatible with UVa.
10/02/1998	Video added.
11/1998	1 ISU student dropped (to focus on preliminary exams).
01/1999	Second group of pilot courses began.
03/1999	SITE conference presentations.
01/1999 – 08/1999	CITE Leaders wrote grants & scholarly papers; continued collaboration for scholarship and policy development.
08/1999 – 12/1999	Discussed collaboration with P-12 schools.
01/2000 – 08/2000	Continued to collaborate with P-12 schools on technology incompatibilities and possible research opportunities.

The Course: Diffusion of Educational Technology. Two UVa Assistant Professors offered this course in Fall 1998. ISU students enrolled in an independent study course with an instructor of record. This provided graduate students at both programs with an opportunity to learn from another academic culture and to expand expert offerings. This course had been taught prior to Fall 1998 to UVa students; however, it had not been team-taught.

Faculty divided this course into two sections: theoretical and practical. The theoretical focused on policy theory and the impact of cultures on the development and implementation of policy; the practical examined policy in practice with emphasis on how technology affected policy development. The four course

objectives were: (1) understand fundamentals of the policy process, impact of culture, and application to educational technology; (2) experience technology innovation within educational organizations; (3) explore relationships between policy and practice in the area of educational technology; and (4) create a collaborative learning environment. Faculty structured learning in a seminar format grounded in inquiry and collaboration with student assessment based on participation and a culminating group project.

Students were connected in this course by using communication technologies, which were chosen in Summer 1998. The initial plan was to begin with basic components and add increasingly more sophisticated resources as the course progressed. The setup of the technologies was not a commercial self-contained unit, but a process of selecting technology to best support the expectations of the shared courses. Technology components were divided into three categories: audio, data, and video conferencing. Each site developed an electronic classroom by using compatible technologies (see Figure 3).

A full duplex conference phone was used for the audio. Data were also shared by linking electronic whiteboards using Microsoft NetMeeting software, a free component of the Internet Explorer browser. The computer was operated with a wireless keyboard and the display was projected on an electronic whiteboard or screen. With the NetMeeting software, one group presented an application, such as a Word document on the screen while the other had the option to modify the same document from their site. In essence, the two groups were sharing one file to create a shared document. This document was saved on both computers, so both sites had

copies. By using another communication technology, asynchronous discussion groups, students read postings at their leisure and pace, reflected on their reactions, and wrote and revised what they wanted to share with the class.

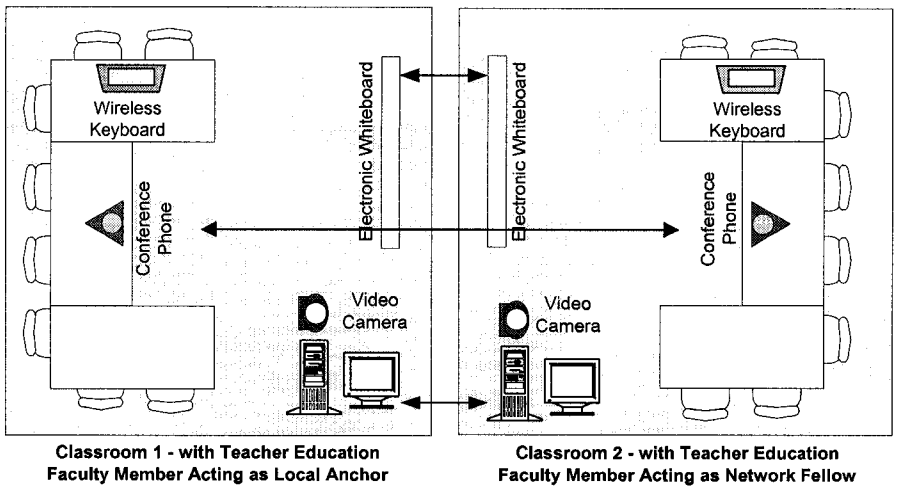

Figure 3. Prototype collaborative education classrooms (GB, Catalyst Grant, September 1999, p. 14).

Both audio and data conferencing equipment supported collaborative interactions. Thus, in the beginning, students at the two sites, about 1,500 miles apart, heard each other; discussed topics by posting messages on the discussion groups, and shared files and other computer-based data via electronic whiteboard software. However, an additional technology, video, was to be added in less than one month from the beginning of the course.

With the addition of close-to-full motion video, students were able to see each other as their images were displayed on a screen (ISU) or on a large monitor (UVa). Both universities had access to Internet 2, the experimental version of the Internet that provided a faster data transfer and higher bandwidth. This made the high quality

video possible. The hardware to make the connection was a special video card made by VCON that was installed in Windows computers. Computer software, Meeting Point, which came with the video card, was also installed. A typical video camera for Internet use (but with remote controlled pan/tilt/zoom features) was connected via a RCA cable to the card.

The classrooms were arranged so students felt as if they were physically facing the students located at the other site (see Figure 3). This layout also supported student-to-student interaction between sites rather than enhancing the interaction within each individual site.

Subjects

The primary source of data was the students. Faculty, technical support staff, and CITE leaders provided contextual information for the setting as well as triangulation information for the data. In this case study, there is an unusual high amount of staff and faculty involved in the shared graduate course. This course was one of two pilot courses offered in the fall semester. Therefore, the interest of sharing this graduate course increased with using the communication technologies and collaborating with another educational technology graduate program. This interest is reflected in the almost double of staff and faculty compared to the number of students. Within the pilot year, more than 50 graduate students participated in the four courses. The following table (Table 4) provides a visual of the participating groups.

Six doctoral students (three from UVa and three from ISU) either enrolled or audited the course. Four students were instructional technology majors; one majored in English and one in educational psychology. One ISU student, majoring in instructional technology, dropped the course to focus on preliminary exams. The students' voices provided an understanding of dynamic interactions. Although most of the students were majoring in instructional technology, few of the students had experience in taking a distance education course.

Table 4. Participants.

Participants	UVa	ISU
Students	3 (1*)	3 (3*)
Faculty	2	1 Instructor of Record (Did not attend the course)
Technical Support Staff	3	1 (also student)
CITE Leaders	3	3

Notes

1. Students with a * specialized in technology in their doctoral degree. One student from ISU dropped the course to focus on preliminary exams.
2. The participant researcher was also a graduate student and technical support.

Students began with introducing themselves via audio; an activity quite similar to the first day of a brick and mortar course. A more detailed introduction of each student was posted on the discussion group. By introducing themselves, students were able to provide a foundation for further interaction. For this study, students' names have been changed for the purposes of reporting the results.

From UVa the students were Linda, Lucinda, and Lucy while at ISU the students were Molly, Mary, and Mike. The students at each site knew each other, had some understanding of the other institution, and had some experience with

technology. However, the technology setup for the course was new to all. Only one of the students had direct experience in policy development at the state level, which was the basis of the course content.

Linda was a second year doctoral student in instructional technology. She had planned to go into communications; however, she spent time working with K-12 teachers and developed an interest in training in-service teachers.

Lucinda was a doctoral student with a degree in English. She enjoyed writing and was the communicator in this course. In her introduction, she provided additional on-line information on her interests, which reflected her exceptional writing ability.

Lucy was a doctoral student in educational psychology with an emphasis in teacher simulations. She had a background in public television and audiology.

Molly had completed her oral exams for the doctoral degree in curriculum and instructional technology. She had taught several years in public schools and had experience with policy development at the state level.

Mary was a doctoral student in curriculum and instructional technology. She had a background in journalism and was editing for a technology journal.

Mike was a doctoral student in curriculum and instructional technology and had a teaching degree in technology education. He had an extensive background in web page development.

Most of the students were international travelers, and they enjoyed learning about new cultures and customs from around the world. Only one student was a native to the state where he/she was taking the course.

Neither of the UVa professors had extensive backgrounds in instructional technology, but had used technology in previous courses. It was the first time for one of the professors to teach this course. Although this course had not been team-taught prior to this offering, the interpretation of team-teaching was different than simultaneous sharing of teaching. The course was divided into two sections: policy and practice. Each professor taught his/her respective section. Although, at times, both were present, the professor responsible for the current section led the discussions. The other observed and participated on occasions. The observations were more beneficial for the second professor as technologies were added during the first half of the course. Both appeared to struggle with the technology as they pondered how to teach using unfamiliar technologies and working with an unfamiliar culture at ISU (Walker, 2004b).

Technical support staff at UVa included a post-doctoral student, a full-time technical assistant, and a graduate assistant. This group was present most of the time during the two-hour class. If they were not in the room, they were within hearing range. At the ISU site, the only technical support was a graduate assistant. The unusually high number of support staff and other interested personnel was part of this pilot course and other courses during the first year of collaboration between the two educational technology graduate programs.

The CITE leaders consisted of professors, network experts, directors, and other administrators who envisioned innovative approaches to using technology to support collaboration of educational technology graduate programs. Although the CITE leaders were not always present in the classroom, they represented the

contextual understanding and framework for the overall collaboration. They also brought visitors to observe the operation of the technology and interaction between the two sites.

My role, as a participant researcher, included course observer as well as active participant. I informally audited the course, where I completed assignments, read class materials, and participated in the discussions both on-line and during class time, but did not receive credit. Detailed accounts of my observations were also kept in a journal, and I debriefed my interpretations with colleagues. I also asked the students about my understanding through member checks. If I recognized or was informed of possible biases in my interpretations, I wrote down the discrepancies and clarified them with experts and students.

Data Collection

Data collection began in Fall 1998 from the beginning of the course and continued through March 1999 when students and faculty from the course made a presentation at an international conference. The data sources included multiple forms: transcripts from discussion group, focus group, meetings and presentations; course video tapes; e-mail and phone messages; field notes, and artifacts (print and web-based materials, course readings, policy documents, and the course final project).

The data collected were descriptive and provided a rich context of the interactions in the study (see Table 5). The primary data source for this paper was

the discussion group transcripts. The other data sources were used for triangulation of ideas, concepts, categories, and themes.

Table 5. Evidence gathered for data collection.

Data Source	Participants	Volume
Discussion Group Postings	Faculty and students from *Diffusion of Educational Technology*	200 pages [with individual, date, and time stamps]
Observation Field Notes	Observations of *Diffusion of Educational Technology* course	150 pages
	Informal Discussions with CITE Leaders	50 pages of notes
	Informal Interviews and Discussions	50 pages of notes
	Meeting on Internet 2 setup	1 hour meeting with additional 10 hours of follow-up
Faculty Interview Transcripts	Faculty from *Diffusion of Educational Technology* (Used for triangulation of data)	2 x 1 hour interviews (semi-structured)
Artifacts: Video tapes of course in session	*Diffusion of Educational Technology* course (taken at ISU with visual of both the ISU & UVa classes)	15 x 2 hour tapes (all sessions)
Artifacts: E-mail Messages & Phone Messages	Faculty, Technical Staff, CITE Leaders, and Students (sent and received by participant researcher)	Average of 2 messages per day from 1998 to 2000
Artifacts: Video & Audio Tapes	CITE Leaders during CITE meetings	1 x 2 hour video tape; 3 x 1 hour audio tapes
Artifacts: Audio Tapes	Faculty, Technical Staff, CITE Leaders, and Students	Invited SITE: 2 hour presentation
Artifacts:	CITE Leaders (Planning documents) UVa and ISU web pages Professional Organizations	5 Documents 10 web pages Policy Documents

The discussion group postings were printed out chronologically from the newsgroup. The date, time, and students' name were printed on each page of the postings. I used different highlighters (yellow and pink): one to highlight students' postings and the other for faculty members' postings. The postings were kept in chronological

order for analysis purposes. Any analysis notes were highlighted in a purple highlighter. I also used transparent flags that ranged in colors to highlight postings that represented tentative categories emerging from the data. This provided a visual from the spine of the bounded postings on different topics and frequency of those topics.

Field notes were kept separate from the other data collected. I also divided the field notes chronologically. I entered my observations of the two-hour class, and, within an hour after class, I jotted down ideas and feelings of what transpired on a separate page. At the end of the day, I interpreted what I observed. On a weekly basis, I reviewed my notes and examined them for commonalities and initial categories. For example, on September 11, 1998, I recorded that the class was discussing the scanned files located in the reading section on the course web page. When these files were printed out, they were not legible. The type was blurred to the point the characters appeared to blend together. One of the faculty members discussed options and decided to send the course readings to the Iowa students by overnight delivery. It was also noted that Linda had posted a question about the files on September 6, 1998, but the next response on this subject was not posted until September 8, 1998, by Molly. After class, I described the observed feelings and ideas including the students' surprise of missing the first posting, as well as relief that the readings were going to be sent to ISU rather quickly. At the end of the day, I examined how waiting for course readings was different than buying the course packet at an on-campus bookstore. I also looked at how students missed or possibly did not know how to post within the first week. There were 12 postings at that time

consisting of two students' introductions, one content question, five on technology, three from faculty, and one saying "welcome." The disconnected postings reflected the interactions within the discussion group at the beginning of the course.

Faculty interviews were audio taped and video taped. The interviews contained open-ended questions to better obtain meaningful data (Ely, et al., 1997). The questions were categorized into these areas: classroom climate/ culture, technology, consequences, and infrastructure. I asked faculty members the same questions with follow-up questions to clarify their responses. The audio tapes were transcribed and printed out for analysis. The video tapes of the interviews were used to view body language and to provide a back up for the audio tapes. The interviews were was used as a primary source for a separate paper on faculty's experiences on rediscovering pedagogical strategies within a technology-driven environment (Walker, 2004b).

Artifacts were gathered from the beginning of the course. This included: video tapes of the class in session, e-mail and phone messages sent to me from participants, audio tapes of CITE meetings, audio tape of meeting and presentation at a conference, policy documents, print copies of web pages, students' final projects, and other documents. Artifacts provided supporting evidence for emerging themes. For example, course video tapes provided a visual of the interaction between the two sites. The tapes were used for triangulation of categories, themes and to check my potentially biased interpretations from data sources. The following describes the analysis of the data collected.

Data Analysis

When conducting qualitative research, there is a balance between starting data analysis at the initial data collection and waiting until the completion of gathering data (Maxwell, 1996). I was concerned my findings were biased by beginning the analysis right away. However, with the extent of data collected, starting the analysis after the initial collection enabled me to manage the data and to thoroughly examine all the data. Therefore, I balanced my desire to begin analysis with attempting to recognize my biases. I also took measures to ensure my interpretations were contextual and not personal by writing my concerns in the field notes and asking students and colleagues to check the validity of my interpretations. For example, as the ISU technical support person, I was concerned that my degree of technical knowledge of the equipment blinded my perspective by underestimating students' interactions in this environment. I continually conducted member checks with the students as well as asking other students who were taking a different pilot course shared between the two programs. This continual process assisted me in being aware of my biases and possible influences in this study.

The following section describes the analysis of the data sources. After this description, the emerging themes are presented including my thought processes and evidence of how I evaluated the categories that led me to the themes. This section closes with a discussion on the connection between the themes with the literature presented in this paper, in particular, activity theory.

Data description

Data sources included discussion group transcripts, field notes, course video tapes, course materials, and other artifacts to support course content. My analysis began with reading all the raw primary data sources such as the transcripts and the field notes, which enabled me to develop detailed knowledge of what was contained in the data. When I went back to reread for clarification, I noted my first impressions by creating a visual. This analysis tool aided in identifying tentative categories (see Figure 4) (Strauss, 1987).

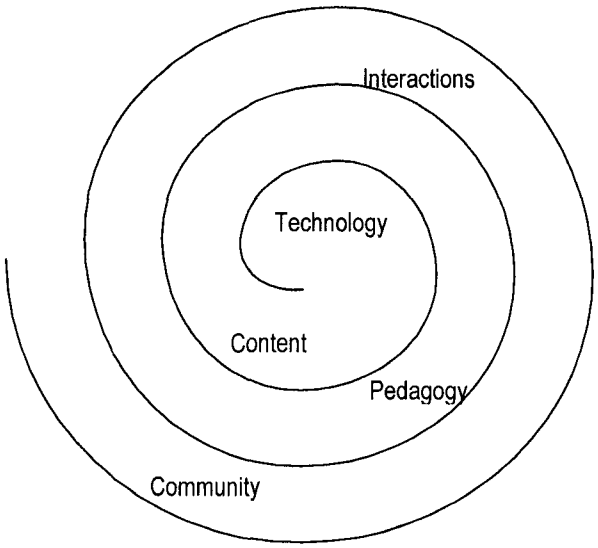

Figure 4. Tentative category visual representation.

This spiral represented a visual of the flags that were placed on the discussion group transcripts. By examining the placement of the flags, there were twice as many technology postings, represented by pink flags, than any other category in the beginning of the course. The first content posting (represented by yellow flags)

occurred two weeks after the course began. By the time this first content posting was made, there had been 36 previous postings. Periodically faculty posted prompts and suggestions to attempt to move the postings toward a conversation while minimizing disconnected postings. Interactions, represented by orange flags, increased when students began the final project. The spiral represented the overlapping movement as students progressed in their on-line discussions from technology through content to their growth as a group. Therefore, there were continual movements forward and backward throughout the course.

All transcripts were first read for understanding as noted by Figure 4. I then reread them to find similarities or contradictions with other data. After reading the data twice, I began to code line-by-line where I read each line of text and underscored keywords or phrases (Strauss & Corbin, 1998). With this detailed coding process, I was able to closely examine the data, check my understanding, and begin refining the categories (see Table 6).

When new data were gathered, I recursively examined the new data and compared it with previous data analysis. The continual data collection enabled me to review and to validate previous analysis. I noted any discrepancies and then reevaluated the categories. From this reevaluation, I determined if this was an abnormality or required refinement of the categories. Once the categories were supported by existing and new data, I began to lift contextual evidence from the data. This kept the integrity of the context by not stripping away the background of the data (Guba & Lincoln, 1998).

Table 6. Coded material from discussion group transcripts.

Transcript Excerpt Posted September 16, 1998	**Coding** Categories are in [ ] within the text.
I as well miss the eye contact with everybody in the class [Visual sensory; interaction]. I hope that we can meet someday face-to-face so we can discuss and interact [human contact; interaction]. I have enjoyed looking at the pictures on the web of UVa's site [Identity; community]. We will have pictures soon as soon as I can round people up [Conforming identity; community]. This Friday is my d-day for pictures [Rules; community]. I have found that the telephone has taken a "human" personality [Cultural; technology]. We spend so much time focusing on the phone that we forget who else is in the room [Communicate; technology]. The phone has been changed to a Polycom and it worked well on Monday night [Contradiction]. I believe as the course goes on that the technology may fade into the background more and the course content will emerge more prevalent [Mediation; technology]. We appear to have a relationship already through the technology [Community]. It will be interesting to define that relationship [Community]. Thank you :-) [emoticon; possible interaction]	

In summary, with each phase of gathering data, I recursively examined and compared with previous collected data for the distinct purpose of refining categories and further examining for themes. For example, one of the categories was community. From the discussion postings, Lucy apologized for the length of her message, but wanted to check in with others to see what they were thinking. This illustrated that at least one student was reaching out for others' viewpoints. I wrote community in the margins by this posting. In the field notes, I examined for evidence to support community within a few days of this posting. Next day in the notes, the class met for their weekly session. I recorded in the field notes that students were posing questions over the reading material for others to ponder. This was similar to the posting as it supported students asking each other for further input. I continued this process of identifying supporting evidence and triangulating with other data

sources. The following describes the themes that emerged from this process of recursive analysis (Ely, et al., 1997).

Themes

From the categories in Figure 4, three themes emerged from the data. These themes are technology, community, and content. Although pedagogy appeared in the discussion group postings, it was not a major theme for the students. Pedagogy was another layer of the activity that is described in a different paper (Walker, 2004b). The following sections describe the themes from the students' perspectives (Ely, et al., 1997).

Technology. From the discussion group transcripts, field notes, and course video tapes, technology emerged as a theme. By looking at the flags attached to the transcripts, technology was discussed more at the beginning of the course. After two weeks, the first content entry was posted. After rereading the postings marked as technology, I noticed students were not talking directly about the types of communication technologies. I had initially believed technology was more about the hardware and software being used to connect the two sites. However, the evidence supported their discussions about their experiences with the technology and not about the technology itself. With this information, I began to alter my initial views of the technology category and to investigate further in other data sources. In the field notes, I noted their preoccupation with the conference phone within the first weeks of the course. I also reviewed the course video tapes during this time period to triangulate the emerging theme. From these sources, I determined that the phone

was crucial to their connection with the voices at the other end of the line. The phone was not the focal point; rather its function was the focal point in this setting. As I went through refining technology, I asked other students in the course what their impressions were on the technology. They commented that having the opportunity to take this course and learning more about technology's functions were important to them.

I examined in the data for similarities, differences, and unusual instances as each technical component was implemented. I continued this examination throughout the semester as I investigated technology's functions in this setting. From this process, I noticed from the beginning to the end of the semester technology moved from the status of tangible object to an invisible mediator. I also discussed this transition with a faculty member. She also supported this movement as demonstrated by the evidence in the different data sources. While technology was changing from one function to another, this movement to the background also intertwined with students developing as community of learners.

Community. Community emerged as a theme from examining the discussion group transcripts, field notes, and course video tapes. At first, both community and interaction were identified as categories. After further review, I established these categories were difficult to separate because interaction formed the foundation for building a community. There existed a process of community building through interactions that did not support two separate entities.

I examined in the discussion transcripts and other data sources to see how similar these categories were. For example, interactions among students changed

with each additional technology. With the phone, students were tentative in going beyond answering and asking questions over the material. Students became more comfortable as each component connected another sensory experience as noted in the field notes (Dede, 1996). In the discussion group transcripts, the first shared emoticon was expressed 11 days into the course. The last lurker in the group posted one day after the emoticon was expressed. From the eleventh day of the course, students slowly shared information, revealed humorous observations, and asked questions on understanding within this growing community. From the emoticon, students showed interest in getting to know each other beyond the reading material. This interest was illustrated throughout the transcripts as students started their postings with "Greetings" and "People."

While continuing this exploration, my concern arose on whether community existed or I preconceived its existence. Community was a course learning objective, which I expected to materialize. I discussed this concern with other students. By participating in this course, my experiences of seeing and being within this community provided a different perspective on its growth. I reviewed my field notes with faculty and students in the course. My expectation was a fully functioning unit on the first day of class; however, the evidence illustrated community started to grow with the shared emoticon. I also watched the course video tapes to support or refute the emerging theme. After further review of the data and discussions of my concerns with faculty and other graduate students, community emerged as a theme with interactions forming the foundation for its growth.

Content. From field notes and discussion group postings, content emerged as a theme. Course content covered policy development and practical application of diffusion of technology. Course objectives, as noted earlier in the methodology, included policy intentions and cultural impact of implementing value-laden plans. Students examined the practical application of initiating technology policy within educational settings. For example, by using communication technologies, students were provided opportunities to apply their understanding of using technology to change policy. ISU's and UVa's differing traditions were used for discussion topics during class by the students.

In the discussion group transcripts, I identified a pronounced change in the discussions from students' posting summaries of the reading material, to asking and responding to questions. I was curious about this change and investigated further in other data sources. I noticed the date of several postings and checked to see if anything notable happened on this day. On October 2, 1998, video was added to the connection, which also corresponded to an increase in postings on that particular day. I rechecked the days around October 2 and realized students were exchanging some postings on the course content. I checked with a faculty member on this coincidence and determined that there was a slow growth pattern in the interactions prior to the video. However, the video presented another sensory experience for students, which increased interaction and the growth of community. It also changed the learning outcomes as students' content discussions changed from surface summaries to deeper understanding of the material.

In summary, three interrelated themes emerged from the comparative method and triangulation of data: technology, community, and content. After researching educational change models for another paper, I found a framework, activity theory, with which to analyze interactions within educational settings (Walker, 2004c). Previously in this paper, activity theory was introduced. After further review, this framework was beneficial in analyzing interactions in the data and among the themes of this study. Activity theory provided a framework to make sense of the data, in particular, the connection and relevance among data pieces (Maxwell, 1996). The following table (Table 7) illustrates the connection among the themes from the data analysis with activity theory (see Table 2).

Table 7. Analysis comparison of activity theory, themes, and community.

Activity Theory (Kuutti, 1997)	**Theme: technology**	**Theme: community**	**Theme: Content**
Subject		Identity	Understanding
Community		Interaction	Cross Cultural
Object		Final Project	Learning Outcome
Tools	Tools	Mediation	
Rules	Communication		
Roles	Intellectual Partner		

The first column presents the elements of an activity (Kuutti, 1997). The first three elements form the central triangle that portrays subjects, collaborating within a community, are motivated to achieve an object (See Figure 1). These elements have been described as interdependent elements (Hung & Chen, 2001). Interdependency is individuals encouraging group members to achieve the group goal or object (Geer, 2000). The remaining elements (tools, rules, roles) mediate the dynamic interactions

within this setting (Hung & Chen, 2001). The mediating elements form the supporting infrastructure.

Within the technology theme, technology performs many functions (e.g., tool, communication, intellectual partner, mediation) (Jonassen, et al., 1999; Walker, 2004c). Tool function provides a structure for students' knowledge construction (Jonassen, et al., 1999; Walker, 2004c). Another function, social medium or communication, connects students so that they can negotiate meaning and understanding (Jonassen, et al., 1999; Walker, 2004c). Intellectual partner function supports students' learning by helping them articulate what they know. For example, cognitive tools engage students in thinking while they construct knowledge (Jonassen, et al., 1999).

Technology performs a mediation function as students (subject) are motivated to achieve the course objectives (object). This mediation brings sociocultural history specific to the tool that shapes how the community acts within a particular setting (Kaptelinin, 1997). For example, electronic mail (e-mail) has altered how students communicate with each other. This technology lacks visual cues; yet, students have modified their textual messages by adding emoticons as a substitute for emotional discourse (Herring, 2001). E-mails have also altered students' expectations for turnaround time for responses from days with snail mail to seconds with e-mail. In this study, many flexible technology components mediated the setting. The last component, video, affected some students' perceptions of their body image as their image was carried and displayed by the camera and projection equipment (tools).

Students interacted with each other through technology to form their identity and to form a collaborative community (Wenger, 1999). For example, students asked each other questions over the course material. They also negotiated the final project (rules). From their interactions, a community slowly developed over the semester to support this task. The final project demonstrated their knowledge of the course material (object). By completing this project, they accomplished the course objectives by applying their understanding and experiencing this shared course with another university's traditions.

In summary, a student (subject) strives to achieve course objectives (object) through mediation of communication technologies (tools). They form a collaborative community by developing rules for engagement as well as division of labor (roles). These rules and roles emerge in the final project. Activity theory provides a framework to examine the interactions from multiple perspectives and to connect the data within the setting. This framework illustrates the relationship among the themes (technology, community, and content) as elements of a complex and dynamic activity. By using activity theory, the data is constructed within context that clarifies and explains what is happening. It also provides meaning to the evidence collected and structures the story of the students' experiences. This relationship (as presented in Table 7) illuminates particular events as well as draws attention to interactions that may have gone unnoticed.

The results are presented according to the themes. At another level of analysis, activity theory is used to investigate the interactions within this setting.

These interactions are among the elements shown in Table 7 and are discussed in the discussion section following the results section.

Results

Students' voices are described in the results section. Their experiences are organized according to the three themes: technology, community, and content. Each theme begins with an introduction, followed by the report on the data on students' voices, and closes with a summary. At the end of the results section, an overall summary is provided.

Technology

Communication technologies connected two virtual classrooms in this study. In the first month, these technologies were gradually implemented. Students' experiences also progressively changed over the semester as they became more comfortable with this environment. The following describes students' experiences within this technology-driven environment.

Students' voices

In the first week, students concentrated on the phone as they struggled with identifying voices and names from the other site. From the course video tapes, each student announced his/her name prior to speaking, which provided an awkward entry into discussions. While listening to the UVa site, ISU students attempted to anticipate pauses between UVa speakers. Without visual cues, ISU students were

unsure when to wait their turn and when to speak. In the field notes, I recorded on September 11, 1998, ISU students muted the phone to clarify comments made by UVa students on course mechanics. Although ISU had the phone muted for approximately 4 minutes, UVa discussion continued from the course mechanics to the latest development in policy modeling. The physical presence of UVa faculty promoted more spontaneous discussions at their location, while ISU students attempted to time their responses between UVa speakers.

With this method of speaking, the intended conversation was stilted as students formally introduced themselves prior to speaking. However, the experiences at ISU were unknown by the UVa site. Lucy commented:

> For me the course is going well with the exception that I miss the eye contact with the folks in Iowa.

While at ISU, Molly stated:

> I have found that the telephone has taken a "human" personality. We spend so much time focusing on the phone that we forget who else is in the room.

By focusing on the phone, ISU students joked about naming it Charlie. ISU students believed they were interacting more with the phone than with the UVa students.

The phone functioned as a social medium between the two sites. In the beginning, students were separated by the phone as well as distance. ISU students were not sure how to interact with UVa students through this technology. Mike observed:

> I like that kind of technical stuff and I'm always looking forward to seeing what can be done next. It adds a little extra excitement to the class. (What happens

> if we come into class and you're not there?) But, I think sometimes it would just be nice to see you raise your hands while you are talking or nod your head when you agree (or disagree).

This observation shared in the postings illustrated their experiences as ISU students balanced the excitement of using the technology with their desire to become better connected with UVa.

Along with the phone, faculty used the electronic whiteboard to present information on the course syllabus and on-line resources. In the beginning, the whiteboard delivered information such as the syllabus. Over time, it provided a structure for students' knowledge and thus functioned as a tool. For example, on November 20, 1998, students were discussing Bowers and the non-neutrality of technology. From the field notes and the course video tapes, students used their discussion on Bowers to move into critically reflecting on the relationship between power and knowledge in teaching practices. At each site, students discussed this relationship and published their notes in a Word document through the whiteboard software. Although each site discussed separately, they shared their understanding by presenting their documents and continued negotiating the meaning of power and knowledge. These documents were later used in the final projects. With the support of the technologies in this activity, students shared textual documents through the whiteboard, heard each other explain these documents, and saw images and nonverbal cues of the speakers. In the field notes, I recorded students' excitement about using the equipment and sharing their understanding with others.

Tool function was also illustrated in the discussion group postings. After presenting posting guidelines and negotiating interactions during class, a treasure hunt was posted by an UVa student at the end of the second week. With this task, students explored using the discussion group. The purpose of this hunt was to assist course designers in structuring postings to fit students' needs in constructing knowledge. Students' particular tasks were to access the discussion group through the course web page, manage their postings, and reply to others.

Postings also evolved as students became more comfortable with the technology. At first, students were unsure how to use this technology. Mike posted:

> It took me an hour to write my bio because I was so concerned about what to say and how to say it. Then after I posted it I wanted to change things again, but it was too late, it's there for good. Maybe this will come with time though. If I get to know the system and the people I'm talking with maybe I'll be more comfortable. I guess only time will tell.

This posting echoed the sentiment of other students. By being unsure of the technology and others' reactions, they were cautious with composing their postings and often waited for someone else to begin. For example, in the first half of the course, the longest string of postings was five, on identifying key players. However, students were adding information without directly responding to other postings.

During the second half of the course, students increased their interactions in the postings as they developed the final group project. As they became comfortable with the discussion group, students used the postings to negotiate meaning of defining educational technology and to share their understanding of policy intentions.

Discussion group functions also were modified over time. Postings initially functioned as a tool when students used the treasure hunt to demonstrate their knowledge of discussion groups. Students also used the postings as a social medium to communicate their definition of educational technology.

Adding video conferencing in the fourth week changed the dynamics of the class. Even though video added another sensory experience, students were apprehensive at being viewed by the camera. Their anonymity, assured by voice and discussion postings, was revealed with video. The video hardware had a picture-in-picture capability, where the larger picture displayed the other site and the smaller one was the home site. At first, students were uncomfortable and distracted as they looked at the other site while trying to avoid their own displayed image. One student moved to avoid looking directly at the video projection. By turning away from the camera, the other site was not able to see all the students, in particular, their facial features.

In response to this concern, the equipment was rearranged as reflected in Figure 3. The "home" picture was also turned off to permit students to view only the other classroom (Walker, 2004b). With the video connection, students placed an image with the voices; however, they were apprehensive in watching themselves and knowing others were seeing them. In this instance, what appeared to be transmitted video contradicted the actual influence of this technology in the environment. The video carried students' cultural interpretations of interacting with intangible moving pictures versus tangible physical contact. Pictures did not appear real to some students and proved more distracting as they became preoccupied with

their own image. This distraction overwhelmed some students as they attempted to interact with others.

However, shortly after the video was added (October 2, 1998), postings increased as students began to interact. By the end of the semester, course video tapes provided supporting evidence of the inclusion of all the students in the pictures being transmitted to both sites. Students, who were distracted by their images, were turning towards the camera to answer questions by the other site and to share humorous observations from the course material. These observations included commercials seen on television that reinforced the power structure mirrored in policy intentions.

In summary, technology's functions evolved during this process as students became more comfortable with the components connecting the two sites. These functions were information vehicle, tool, communication, and mediation (Walker, 2004c). The whiteboard functioned as an information vehicle when material was presented to both sites. Students used the phone, as a social medium, to connect with the other site. The whiteboard was also used as a tool when students created shared documents using Microsoft Word. The video's mediation function distracted some of the students. This function carried cultural knowledge and social experiences based on interactions within previous and present activities (Kaptelinin, 1997).

In the first weeks, students were having difficulty in connecting with students' voices. With the phone, their conversations were not spontaneous as students formally announced their name prior to speaking. The auditory capability of the

phone shaped the delivery of the discussions. Students were not actively interacting with the virtual site as they were at each respective physical site. However, by the end of the semester, technology evolved from tangible objects to invisible mediators as students explored the emerging community and course content.

While students experienced technology, they began to negotiate meaning, share understanding, and continue exploring of the course content. Their interactions formed building blocks for community development (Palloff & Pratt, 1999). Their stories of this collaborative community are described next.

Community

To create a collaborative community, the informal group jointly commits to the completion of an identified task (Wenger, 1999). For this shared course, the common task was the completion of the final project. Students designed the project to compare and contrast educational technology policy between the states of Virginia and Iowa. Throughout the semester, students laid a foundation for creating the conditions to "think" together by posting ideas, responding through e-mail and discussion postings, and conversing through real-time conferencing. The growth of this collaborative community emerged within this technology-driven environment.

Students' voices

During the first class meeting, Lucinda presented her "collaborative lesson in goodwill and good humor" (Lucinda, Personal Communications, September 4, 1998). This presentation invited negotiations for what were acceptable practices in

this new environment; however, these negotiations were slow to materialize. Students first had to make a personal connection with the other site.

These connections were slow as students juggled technology, content, and the distance from the other site. They wanted to connect with all students, but were unsure of how to start the process. Linda had shared her concern of not making "a 'real' connection with the Iowa students." Linda stated:

> I think the biggest effect will be on how information is transmitted. I can't imagine what it's like for Molly, Mary, and Mike to be concentrating on audio transmission without a visual of the person who's speaking.

For UVa students, the course changed as they became more aware of ISU students' lack of input. Both sites agreed to work on bringing everyone into the conversation. This inclusion was the initial step for community development. Molly summarized ISU's experience a few days prior to this agreement:

> I believe as the course goes on that the technology may fade into the background more and the course content will emerge more prevalent. We appear to have a relationship already through the technology. It will be interesting to define that relationship. Thank you :-)

On the same day, Lucinda responded with an emoticon in her posting as well. Her posting illustrated her humor as she reflected on the readings. Lucinda commented:

> I would like to conclude a few of my research papers this way. . . 'And in conclusion, I really have not point. . . :-)

She continued:

> The elder provides counsel for the younger. . . during office hours at least. :`)

This was eleven days into the course that marked the first shared expression through the use of emoticons. By using the emoticons, students were reaching out through the postings to find a connection with others. As Molly shared in her posting, they were attempting to define their relationship through sharing emoticons.

During this time period, students were becoming slightly more at ease with current technologies used in this setting. Although the phone and postings were not routine for the students, they were attempting to look past technology into who were the students at the other site. Mike summarized the class's slow transition from focusing on technology to developing human connections. He was the last student to post an introduction, which also occurred on the same day as the shared emoticons. Mike stated:

> Sorry it took me so long to post to the newsgroup, but I've never used this before and I'm a little reserved about what I'm doing, what I want to say and how to say it. In addition, I was enjoying "lurking" and reading what everyone else had to say. Now that I've started talking, I can't stop. . . so I'll end it here and save it for class.

Mike's statement reflected a common preference: students preferred discussing during class time versus using the postings. They also commonly posted within an hour prior to the class. By posting once a week within a few hours of class, students lacked the time to reflect on other's postings and tended to post comments or inquiries. Molly reflected:

> I expected people to respond to me after I introduced myself in the postings, but no one responded to me. I felt left in cyberspace.

Molly's reflection echoed the mixed reactions to discussion groups. Contrary to Molly's fear of isolation, Lucinda believed it was a better method of introducing herself by connecting informally with others in the class. However, when conversations became more personal, students were hesitant to share information in the postings. Linda shared her reluctance:

> I think it has to do with not being able to take my words back after they are already posted and also the problems that arise when things get misconstrued in translation. Because we don't really know each other yet, it's hard to read tone into a discussion group posting.

While Molly wanted to hear from others and Linda was reluctant to post, students also addressed their lack of confidence in their writing skills. For example, Molly felt inferior with what she wrote as compared to other postings. Although their intentions were to share content, she interpreted the more lines posted demonstrated a better reflection and understanding of the material. While Molly was embarrassed in writing so little, Lucy felt apologetic for writing what appeared to be too much. Through what she called her ramblings, Lucy reached out to others to establish discourse. However, some students were not ready to begin sharing as they were still dealing with the technology.

Students experienced a roller coaster of highs and lows as they encountered glimpses of community and stumbled through technical glitches or misses within the first month of the course. This is represented by the highs of students sharing emoticons and everyone participating in the postings. The lows were timing of postings, fear of isolation in cyberspace, and lack of confidence in their writing skills.

However, they began to encounter more of a growing relationship with each other when video was added on October 2, 1998.

With the addition of video, students' sensory communications moved beyond audio and text. Although video seemed to complete the environment, there was a delay of a few seconds between hearing the voice and seeing movement of the speaker's mouth. This delay between voice and visual was outweighed by the positive responses toward being able to see the other students in motion. When students realized there was a delay, they shared a humorous moment as they chuckled over the differences between audio and video.

Both sites also commented on connecting the voice with a live body where students conversed with the "whole" person and not just the voice (Mary & Mike, Personal Communications, October 2, 1998). They reintroduced themselves to connect voices, postings, and visual appearances. Students reaffirmed each other and began to redefine the group. By taking the time to reintroduce each other, "informal talk" emerged. Molly indicated in her reintroduction on October 2, 1998:

> We were here at 7:00 am . . . with our make up and hair done. . . and got rained on. . .

This was a different type of discussion as compared to the following comments made a few days earlier. Linda posted on September 24, 1998:

> Class, . . . (Note, I always find it awkward to begin my postings to people that I don't know that well, so please bear with me).

As opportunities for interaction increased, students also brought more humor into their discussions. This informal talk gave students a sense of belonging in this setting. Molly stated:

> The richest connection I got is when I called UVa [outside class time] about a question on readings and ended up having a rich conversation about philosophy, beliefs, and a better understanding of the individual. At this point I had a sense of belonging. . . instead of an onlooker.

Informal talk continued as students inquired about Virginia and Iowa cultures. UVa and ISU students asked questions on weather, favorite books, and sports. UVa students raised two particular questions for ISU students: (1) Are Iowa corn fields really knee high by the fourth of July? and (2) Is Iowa the field of dreams? These humorous questions opened the door for ISU students to share what Iowa was really like. For example, Molly shared a family trip to Dyersville, Iowa, to see the "Field of Dreams." The trip was not official until her nephews ran the bases for imaginary home runs. Lucy also requested the location in Iowa of the largest ball of twine. Because ISU students did not know, both sites explored where this ball was located, which was believed to be in Kansas. ISU students also asked about the location of Walton's home in Virginia, which some ISU students had watched the long running television series. ISU students also wondered where UVa's classroom was located on campus. In response to their inquiries, Lucy sent ISU picture postcards on UVa landmarks. These side discussions became more frequent as students got to know each other and felt a part of the group. By engaging others in small talk, students were connecting at a personal level.

Although active interactions were slow to materialize in the first month, by the final project, students were sharing information, encouraging each other, negotiating their group identity, and collaborating on assigned tasks. Preparation for one of these tasks, the final project, became the "aha" moment as students experienced the formation of a community. This community forged a sense of "being in it together" as students refocused from experiencing technology to experiencing a learning space created by their community.

For example, students requested more time during class. The class period, two hours, was not enough time for them to discuss content, share their insights, and negotiate a common meaning. By the end of October, they were meeting 30 minutes longer and discussing more in depth on the content. During one of these sessions on November 9, 1998, Molly proposed how "people are talking passed each other and not to each other." Lucy continued Molly's proposal:

> I also agree with Molly's comments about people talking passed each other. . . . How about instead of arguing about this or that, people tried to see each other's points and figure out how to address the real issue of how computers can best be used in a classroom to improve learning.

This agreement of "talking passed each other" provided an interesting "aha" moment as they realized how they talked passed each other in the beginning of this course. They did not address each other as they struggled with technology and lacked a connection with each other. Yet, on November 17, 1998, Molly asked:

> There is so much good stuff in the readings to discuss. . . how do we fit everything in? Such powerful ideas as Papert would say.

Once students recognized the existence of the other site, they began the process of strengthening their connections. The final project provided a shared object for the growing community to achieve.

In summary, students began to find a connection with other students as they engaged in informal talk, initiated conversations, shared resources, and supported each other in this unfamiliar setting. By moving slowly at the beginning of the semester, students were able to interact at their own pace as they began to identify their roles (Repman & Logan, 1996). Within this unfamiliar setting, students entrusted the group with their apprehensions, discovered strengths of belonging to a group, and developed mutual understandings. This shared experience created a collaborative atmosphere where students were continually in the process of developing a community.

This process was flawed at the beginning; however, Linda described the class as a snapshot in time and not the whole movie. Students came to the course unsure of what to expect. By the end of the semester, they were developing an on-line collaborative community. This community was reinforced when they met in person at an international conference. Lucy described it as an opportunity to take the time to meet and "get some real face-to-face time."

From October 2 (video added) to December 11, 1998 (last day of class), technology slowly became an invisible mediator while community gradually grew. Students also changed during this time frame from posting individual ideas to negotiating the final project. The "aha" moment for them was realizing the existence

of students at the other site as their connection through the content emerged from behind the technology.

Content

In this theme, students' voices describe their experiences with two universities' traditions, shared understanding of the course content, and the achievement of the final project. This shared course challenged students' expectations on learning course content and collaborating on a project. By the end of the course, content knowledge emerged in this technology-driven environment.

Students' voices

Along with technical changes, students experienced additional changes to expected university traditions. They were familiar with buying required readings and attending courses on time. These expectations were challenged while taking this shared course.

UVa students had access to the textbooks at their university bookstore as well as from former students who had taken this course. ISU students became aware of the required textbook list during the introduction of the course syllabus. UVa students noted that their bookstore had in stock several copies. ISU students decided to request that ISU bookstore have those books transferred or have them available for purchase. ISU bookstore's policy did not permit them to request these books from UVa. ISU bookstore suggested the students contact UVa bookstore directly to purchase the books. ISU students pooled their money together and called

the UVa bookstore. At first, UVa bookstore was unsure why ISU students wanted these books and pondered if there were extra books for ISU to purchase. With intervention from UVa faculty, students, and ISU instructor of record, ISU students received the purchased books through UPS delivery.

Both UVa and ISU students struggled with the on-line course readings. The readings were scanned and placed on the course web site for students to access. The illegible scanned documents proved inadequate for students to read. Although this was a technical problem, ISU students did not have direct access to the readings located at UVa where UVa students received copies from the professors. To alleviate this unintended consequence, UVa faculty sent the course readings by FedEx to ISU.

Students also recognized on the first day the time difference between UVa and ISU. What appeared to be a simple one hour difference between Eastern and Central Standard Time was revisited continually throughout the semester. Faculty and students were careful to clarify time commitments as they agreed to extend the class period 30 minutes. On occasions, students listed both times (Eastern and Central) in their correspondence with others such as postings and e-mail. Faculty also brought attention to the time difference during class by asking Iowa students if the sun had risen yet.

Although students experienced changes in familiar traditions, Linda also believed technology had the possibility to overwhelm course content. Her belief was reinforced with the technical problems within the first weeks. However, students' interactions progressed through each technical stage. After adding the video,

students' interactions increased during class and in the postings. With this increased interaction, students requested to meet longer than the allotted two hours. Within this technology-driven environment, students balanced between experiencing the technical environment and exploring the course content on diffusing technology. By the end of the semester, students understood the interwoven relationship between experiencing technology and exploring their understanding of the content. They expressed a deeper appreciation of the process of developing and implementing policy. However, students also questioned the intentions of current technology policy regarding the power struggle between the have and have nots. These inquiries formed the foundation for the final project.

With this foundation, students asked questions, shared insights, and instigated negotiations for the final project. As students continued their discourse, they agreed on research questions to guide their project. Linda posted the following negotiated research questions:

> What were the values and assumptions about the policy (in Iowa and Virginia) to fund graphing calculators for middle school students as the policy was being developed? How were these values interpreted in implementation and practice?

Students discussed intentions of policy, practical application of this policy, and abstract wording within policy. For example, Molly requested a common definition for educational technology. This term was loosely used in context in the readings and during postings. She wanted to clarify how others were using this term. It was suggested to use a professional organization's definition, such as Association for

Educational Communications and Technology (AECT). However, others posted additional resources of how to define educational technology. Although they were still exploring this definition, this process provided a framework for them to share information.

The final project began to develop when Lucy posted a question on how rules of policy were created. Lucinda responded to Lucy's posting: "What it was like in the states others have lived in?" Students began a conversation on the differences between Virginia and Iowa. The first noticeable difference was the lack of state standards in Iowa. Virginia had a statewide standards policy for all schools to meet. In Iowa, school districts were locally controlled, where each district designated their own set of standards. Although many of the districts used discipline standards, there existed in essence approximately 400 sets of standards, which represented each district at that time.

This discussion on policy differences between the two states sparked the sharing of national and state key players in educational technology. Faculty formed a matrix from students' discussions and postings. This matrix was later used during class time to critically examine the cultural differences in policy-making activities. This conversation continued into the development of the final project. Students explored a broader view of national technology policy and slowly narrowed the scope as they examined their respective state's approach to technology policy.

Students began to negotiate the final project after the video was introduced. As the community was forming, they shared resources, explored policy intentions, negotiated guiding questions, and committed to the joint project. The structure of the

project was collaboratively decided between the sites; however, through this process, each site (UVa and ISU) worked on their respective state's policy and discussed their progress during class time. UVa posted their findings as they completed their research, while ISU students discussed their findings at their own physical location. ISU students posted a URL link to their presentation prior to the last day. At first, ISU students were unaware UVa students were inviting everyone to think together on this project. This was a missed opportunity to merge two parallel projects. Although the community of learners did not form one shared document, they compared and contrasted what they learned from this task during the last class meeting (December 11, 1998). This reinforced their preference of sharing during class. UVa's project focused on the intentions of Virginia's calculator policy, while ISU's project examined the influence of Iowa's technology policy at a classroom level.

For example, UVa students shared in their final project the intention and impact of Virginia's calculator policy. This policy mandated the use of calculators by middle school students in the math programs. The following is an excerpt from their project:

> We approached the calculator policy using diffusion theory in an attempt to understand the challenges Virginia is currently facing regarding the graphing calculator initiative, and how those challenges are related to equity issues.

UVa students determined from interviewing policymakers in Virginia that the calculator policy was from "a technologically instrumental perspective." This perspective was defined by UVa students to be the belief humans controlled

technology for positive or negative purposes. From their research and interviews, they concluded:

> The technologies like graphing calculators hold the potential to have an impact on teaching and learning. . . making education more accessible when used with experiential approaches that are contextualized in relationship to student lives. Variations in implementation suggest that technology is not just symbolic change but that it also brings us to a turning point regarding leadership and the direction of change within education.

Because Iowa did not have a graphing calculator policy, ISU students examined the School Improvement Technology Act. The intentions of this bill were to fund instructional technology equitably within public schools to ensure education in Iowa was prepared for the 21st century. The following is an excerpt from ISU's project:

> The intentions of policy are that the infrastructure is often bypassed for the glitzy and media-hyped statement of technology improving student learning. . . . public wants a quick fix of dealing with the "apparent" (or is it transparent) lack of competitive test scores with other culturally different educational systems.

For ISU's project, they used focus groups to discuss with teachers and students in the classroom the affects of using technology. From these interviews, they reported:

> When asked what they had learned, math content did not come up with the kids. The "kids" brought up the problem solving, the collaboration, and the connections to real life. Often we focus on the content and forget that the end results are what Papert called powerful ideas. What makes technology so

powerful in the classroom is the capabilities of creating a learning environment powered by and for students and not the traditional classroom. The intentions of the policies reviewed by Virginia (calculators) and Iowa (technology act) were to create technology users for the expected technically advanced society in the 21st century. UVa students interviewed policymakers to determine the intention of the statewide calculator policy. By examining this policy globally, their findings illustrated the possibilities of technology use; however, technology also influenced the change process. ISU students examined the impact of Iowa's policy at the classroom level. Iowa teachers observed technology's influence in the learning environment, where their students used technology to explore math content and the environment surrounding this learning process.

From the field notes dated December 11, 1998, students brought back into their discussions the document created on November 20, 1998, on the relationship between power and knowledge. By negotiating their understanding of power and equity, students found similarities and differences between the policies implemented in the two states. The surface intentions were to distribute technology equally in the schools; however, the interpretations of the policy were modified as both projects reflected the inequitable distribution of training and money. By negotiating their understandings of the course content and applying this knowledge collaboratively, students produced two outcomes from their final projects: (1) deeper understanding of policy intentions and practical applications and (2) the continual process of community development. Overall, they enjoyed this experience. As they became comfortable with technology, students were able to apply and use it. With their

increased comfort level, technology also became more of an invisible mediator within this setting.

In summary, some expected learning practices in taking graduate courses were challenged as students modified how they received textbooks, accessed course packets, and coordinated beginning and ending times of the course. The final project resulted in their questioning policy development and its practical application at state levels. Although students did not formally merge their documents, they compared and contrasted their understanding during class. With increased interactions after the video, this project provided a vehicle for students to collaborate. This collaboration laid the foundation for the growing community.

Summary

In the beginning, students struggled with technology. Along with the technology, students initially found it difficult to connect with each other. Students expressed wanting to know more about the other site and developed guidelines for collaboration and verbal expectations to aid in this process. They attempted to connect one-to-one and slowly moved to include more students. Similar to a spider making a web, students overlapped and retraced their connections with others. As they connected with each other, they began to learn about policy intentions. Their connection supported their negotiations in developing a framework for the final project. By designing this project, students continued to develop a group identity (Collins & Berge, 1996). These increased interactions formed the basis for a

collaborative community. While collaboration developed over time with practice and persistence, they observed that community development was a continual process.

Students valued the opportunity to learn about the course content while sharing their experiences with another university. This sharing also presented challenges for students as they modified their expectations of taking doctoral courses. By examining Virginia's and Iowa's state policies, students obtained a broader and deeper understanding of what were the intentions of policies, who were affected by this policy, how was the policy implemented, and how did this compare with other states.

Students' voices have been presented in the results section. Their voices describe their experiences within this setting including exploring roles, defining rules, interacting with a virtual site, and collaborating on a final project. The following section relates their experiences with the literature.

Discussion

Distance education is subtly challenging students' learning practices as current technologies support active interactions within a community of learners (Armstrong, 2000; Wenger, 1999). To understand these challenges, activity theory is used to describe the complex relationships within the chaotic nature of technology-driven environments (Walker, 2004c). In this setting, conflicts emerge from the interactions among the elements over a period of time. As an analysis tool, activity theory provides a method to examine these interactions and identify contradictions

within a dynamic setting. The value of this framework is moving the analysis from one perspective (student) to multiple perspectives (community).

In this case study, students experienced an on-line collaborative community as two educational technology graduate programs shared a doctoral course, *Diffusion of Educational Technology: Policy and Practice.* By using communication technologies, the two sites were connected with a conference phone, electronic whiteboard, discussion group postings, and video conferencing. Hence, students were exposed to multiple sources of communications where they had access to multi-sensory experiences for the cost of a long-distance phone call (Dede, 1996).

The results section described students' experiences with this shared course. Students (subjects) enrolled in this course to learn about technology policy and practice (object). From their experiences, they began to experience the technology (tool) as students attempted to connect with each other (community). Faculty selected pedagogical strategies to aid in community development; however, technology influenced the initial interactions between the two sites. Students began to negotiate rules and identify technology and policy experts among the community members as they became familiar with the technology and with each other. From their interactions, contradictions emerged. These contradictions were (1) the apprehension between seeing others through the video and being seen by others, (2) preference between discussing during class time and posting their understanding of course content, and (3) balance between collaborating between sites and isolation.

With the introduction of the video, students were excited to see the other site; however, they were also apprehensive to see themselves and have others see them. This is a secondary contradiction between two elements: technology (video) and subject (student). This contradiction emerged at two levels as students (subject) were attempting to understand course content (object) as well as building a connection among community members (community). This community development was also a course objective (object). Although video provided another sensory experience, it also carried cultural perceptions of communicating with an intangible moving picture versus face-to-face interactions. Some students moved away from the camera to avoid its distraction. By moving, they also removed themselves from the other site's view. Video was intended to connect images with voices, but for a time, the available image was also removed leaving just the voice. Some students interacted with a moving picture and sound while others focused on hearing the voices. Students' perceptions of their image conflicted with the video's function of connecting the two sites.

Prior to the video, students were attempting to connect through the telephone. To aid in this connection, the discussion postings were used to provide additional opportunities for students to interact outside of class. The contradiction emerged as students chose not to use the discussion postings while real-time conferencing was available for them during class. This is a primary contradiction between two technologies: discussion postings and real-time conferencing (tools). Students (subject) expected this doctoral course to function the same as a brick and mortar seminar course regarding social interaction (community) and knowledge

construction (object). The spontaneous conversation expected in a seminar was often stilted or disconnected during the first weeks of the course. The phone provided oral communication; however, by stating their name prior to speaking, conversations were difficult to sustain between sites (rules of engagement). At first, ISU students were onlookers as UVa students discussed with faculty. Discussion group postings were implemented to supplement the discussions during class. Yet, students preferred to wait for class to hear the discussions versus to participate at their own pace in the postings. Throughout the course, students preferred hearing voices/seeing images versus communicating through textual postings. Students' expectations of this shared course were challenged as they encountered two technologies to connect them socially and academically. These technologies provided two different methods of communicating: real time and delayed interaction.

Students' roles varied in this process. There were conflicting postings where some students were embarrassed about how little they wrote and others how much. This is a secondary contradiction between two elements: subject and community. Some students were posting information while others were writing for understanding. These two perspectives were at two different points in the process. Some were moving into collaboration while others were addressing technology's influences in this setting. While students attempted to balance isolation and collaboration, there existed expressed fears of being left in cyberspace.

In summary, students experienced this shared course differently than their expectations of an on-campus doctoral course. They reflected on their experiences and shared their insight of constructing on-line collaborations when they met at an

international conference. Technology and interactions were the dominant topics. They agreed technology, with its bells and whistles, facilitated their exploration of the course content but recognized its influence in this process. For example, a conference phone supplied the most reliable transmission of audio, even though the Internet had audio capabilities. This familiar technology was a known infrastructure for the students; yet, even with this familiarity, conversations were difficult initially to maintain between the two sites.

Students believed the creation of a safe and open environment was important to facilitate interactions. In this environment, they experienced unfamiliar technology mediating the connection between two sites. Students required more time to identify with others and to establish their own identity. They encouraged informal discourse in developing trust as they explored together the technology, course content, another university, and each other (Palloff & Pratt, 1999).

For example, in a brick and mortar classroom, students had time to socialize before and after class. There was an understanding of expected rules in their socialization. However, even with audio and video transmission, virtual walls altered students' roles and rules within this technology-driven environment. This was a different experience as compared to walking into a classroom. Technology influenced how they socialized, such as the phone altering spontaneous conversations. On the first day, students did not have before and after class to find out more about their classmates. This course was connected with real-time conferencing for the duration of the class period, approximately two hours. By disconnecting the technology at the end of the class period, the sharing of

information stopped. Although students were to continue their discussions in the discussion group, they were slow in using the postings to socialize with others in the first two weeks. Over time, students slowly socialized with both sites that normally happened the first day of a brick and mortar course.

By listening to students' voices, nuggets of their experiences have emerged from the data. The first nugget is students becoming familiar with the technology prior to connecting with other learners. At the beginning of the course, students were unsure about what the course entailed. However, the technology initially was more of a dominant element than focus on student learning. Students were having difficulty looking beyond the unfamiliar technology. Prior to connecting with others, students had to understand technology's functions in this shared course. Another nugget from this study is students having a sense of belonging to the group prior to working within a community. They initially began to interact when they shared their first emoticons. By sharing emotion and humor, students began to feel a connection with others at both sites. This connection enabled them to begin collaborating on their final project. In other words, their social presence was established before they began to collaborate. This collaboration led to community development. Overall students became familiar with technology prior to connecting with others. In this study, the technology evolved from a tangible object to an invisible mediator while simultaneously students transitioned from individual learners to a collaborative community of learners. In the end, technology was invisibly mediating the setting while the community of learners was continually evolving.

Conclusion

Students' voices, as illustrated in this case study, provided additional sources for faculty and on-line course designers. By describing students' experiences in this setting, faculty and technical support staff gained a better understanding of how to balance technology and pedagogy to create a learning space for their students. Technology was chosen to create a multi-sensory experience for students to explore and to achieve course content. However, students focused on the technology prior to exploring the content and building community of learners. Even though the technology was vital to the sharing of the graduate course, in this case study, it was a visible barrier to the interactions between the two sites. As students became familiar with the technology, they were able to begin discussing the course topics on technology policy and practice. With this transition from technology to content, the students also began to connect with each other as they slowly developed a foundation for a community. Although it was slow to grow, this community was continually in the process of interacting and collaborating on defined tasks such as the final projects.

Activity theory was used in this case study to examine students' interactions during this shared course within a dynamic setting. In particular, this framework illustrated a connection between the themes as these interdependent elements interacted and formed contradictions. The identified contradictions portrayed conflicts emerging among these interactions. I was able to use this descriptive tool to examine the whole setting while listening to students' voices. This process provided a rich description of their stories that were layered to create a picture of their shared

understanding. Describing activities in this environment and identifying contradictions of students' experiences create conditions for educational technology graduate programs and faculty members to transition from transmission pedagogy to learner-centered pedagogy.

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GENERAL CONCLUSIONS

In this case study, teaching and learning practices in a technology-mediated distance education course were examined. I examined these interactions at the classroom level from faculty's and students' perspectives by using a descriptive tool, activity theory. This framework was used to describe the complex pedagogical, social, and technological issues that affected human activity in this experimental distance education course. Along with describing this setting, I used activity theory to identify and understand emerging contradictions among interacting activity systems.

In the first paper, educational change literature was reviewed. Educational change models were presented in this review. The models were organized as a combined approach towards planned change. Ellsworth (2001) named this combined approach as the change communication model. However, Ellsworth's model did not address the complexity of an educational activity, including the chaotic nature of the new demands in distance education. An alternate approach, activity theory, was introduced to address the complexity of educational change. Unlike the change communication model, components of an activity (e.g., faculty's adoption of technology) were not examined as individual entities in the process of implementing planned change. Activity theory was proposed to examine the complexity of a real life environment by recognizing elements from multiple perspectives involved in change and identifying conflicts among those interacting elements.

In the second paper, a description of faculty members' struggle was presented on their creating an on-line collaborative community while rediscovering

pedagogy within a shared distance education course. Although faculty members' intentions were to ignore the technology, they became aware of technology's influences on their pedagogical choices. Within the first weeks of the course, the first faculty member relied on transmission pedagogy to keep ahead of the ever-changing technology and the frequent technical glitches. As technology became more stable toward the end of the course, the second faculty member initiated more learner-centered pedagogy by implementing opportunities for students to share a learning space. During the course of the semester, faculty members transitioned from isolated pedagogical practices toward the creation of an innovative collaborative community.

By using activity theory, I developed an organizational tool (see Figure 1) to describe the interactions between two activities. The triangle on the left represents an expanded community between the two graduate programs. The CITE members were part of a larger community consisting of each university's educational technology graduate programs, professional organizations, and national leaders in the field. Through using communication technologies, the two programs developed a project to achieve the object of this activity which was collaboration. Particular rules were discussed such as similarities between university policies, faculty members' academic freedom, and copyright issues of sharing material. Within the community, levels of expertise were identified such as technical, academic, and administrative. The larger community's activity shared an object with another activity, represented by the triangle on the right. This shared object between the two activities was innovative policies and practices.

The triangle on the right represents faculty members experiencing the shared course, which was the object of this activity. Along with technology, faculty members used pedagogical tools to facilitate the shared course. While faculty had classroom practices expertise (teaching and learning), the expanded community had technical expertise. Other levels of expertise included registering for academic courses and coordinating time schedules for course meetings. Within this activity, university policies were clarified as faculty members learned more about sharing a course with another program. Faculty also reevaluated their practices.

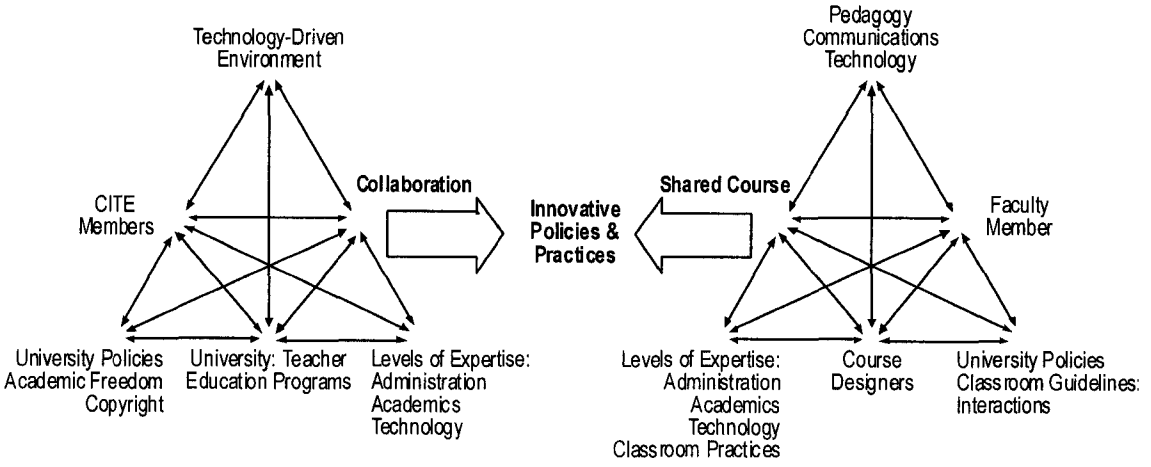

Figure 1. Innovative policies and practices.

In the third paper, students' experiences were described. Their expectations were to learn from content experts and other learners within a doctoral course that they assumed would be similar to courses at their own university. However, the communications technology used to connect the two sites initially influenced students' learning practices. Within the first two weeks, students felt disconnected from the other site. They focused upon the technology more than each other or

faculty. Structured activities, such as a virtual scavenger hunt, began to facilitate the movement of students from focusing on the technology to collaborating on the final projects. By having a sense of belonging in this shared course, students were able to transition from focusing upon technology to focusing upon others. By connecting with others, they formed a foundation for a productive community of learners.

The activity system, shown in Figure 2, represents the connection between faculty and students in experiencing this shared course. The left triangle is the same as the right triangle in Figure 1. However, in this system, the activities are interacting at a classroom level. The shared object between the two activities is the building of community.

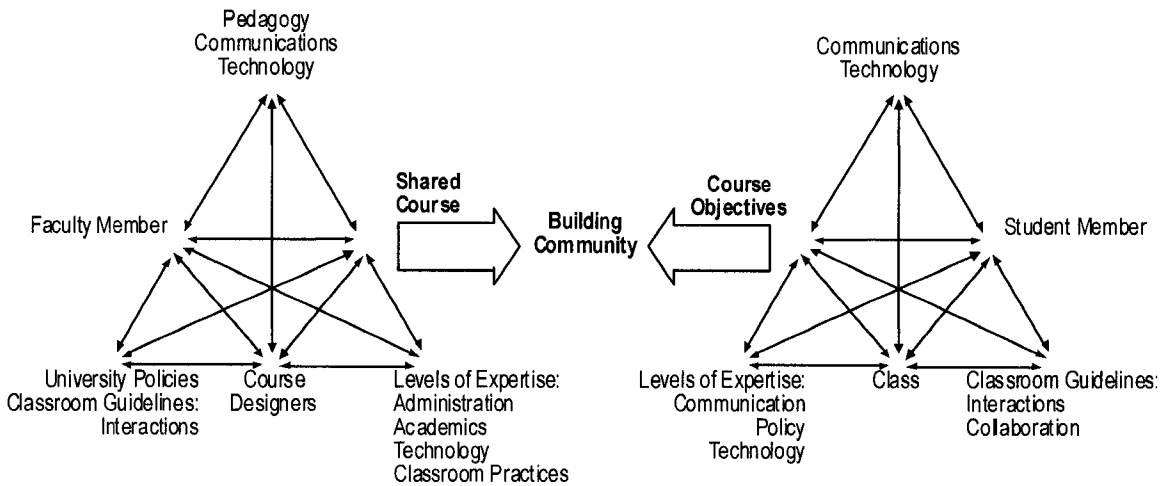

Figure 2. Building community in a shared course.

The triangle on the right represents students' perspectives. In this technology-driven environment, students identified levels of expertise including communications (writing), policy, and technical skills. They also negotiated rules of engagement

during class and within discussion postings. From their interactions, they increased their collaboration as they furthered their negotiations on the final projects.

Through the activity theory approach, rich descriptive data were presented in this study. This framework provided a foundation for examining complex and dynamic activities that were mediated by communication technologies. Activity theory provided a practical application at individual and social levels where the object was to build a community of learners between two graduate programs. From the interactions among the activities, conflicts emerged. Faculty initially encountered a conflict in attempting to form a collaborative learning space. The interruption caused by students identifying themselves prior to speaking into the phone in the first two weeks of the course inhibited the intended conversation between the two sites. The first faculty member did not feel the same personal connection with the ISU site as he did with the physical presence of the UVa students. With the audio transmission, ISU students focused on the phone and they appeared to be listening in on the UVa conversation. For the students, the phone was an initial barrier to getting to know each other. These contradictions were motivators for change. Using additional technologies, faculty encouraged students to initiate conversations between the two sites. By recognizing the conflicts, faculty and students were able over a period of time increase their interactions.

Technology makes it possible for new course structures, such as sharing courses between two graduate programs. With these new structures, learning and teaching became more complex for both students and faculty. Activity theory is a descriptive tool to understand this complexity and enables us to further understand

the interrelated interactions among all elements of an activity. In this study, faculty and students experienced technology's influences in a distance education graduate course. As they became more comfortable with the technology, they formed a collaborative community across two campuses. This type of change goes beyond efficiency of existing practices to creating evolutionary and innovative approaches

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Appendix A. Organizational Tool

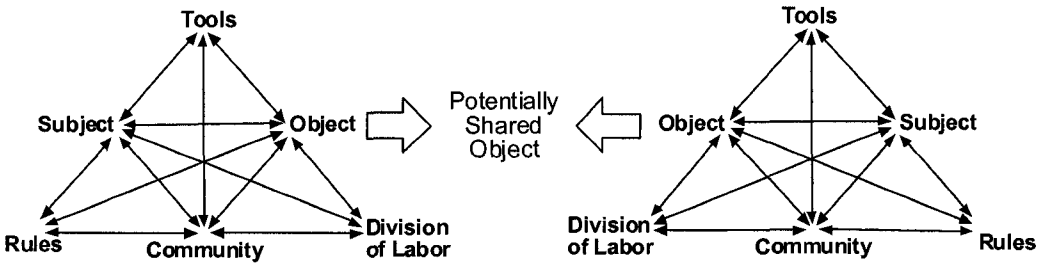


Figure 1. Activity systems.

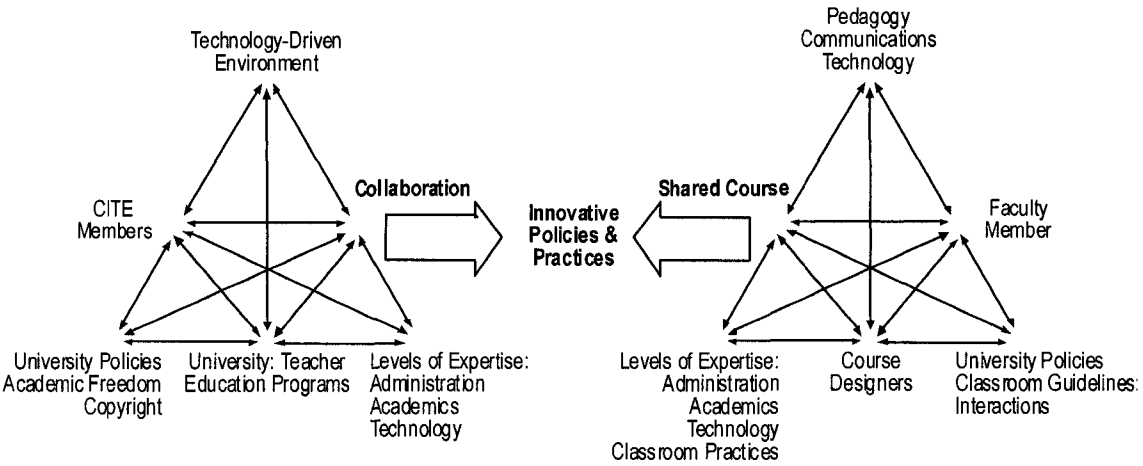


Figure 2. Innovative policies and practices.

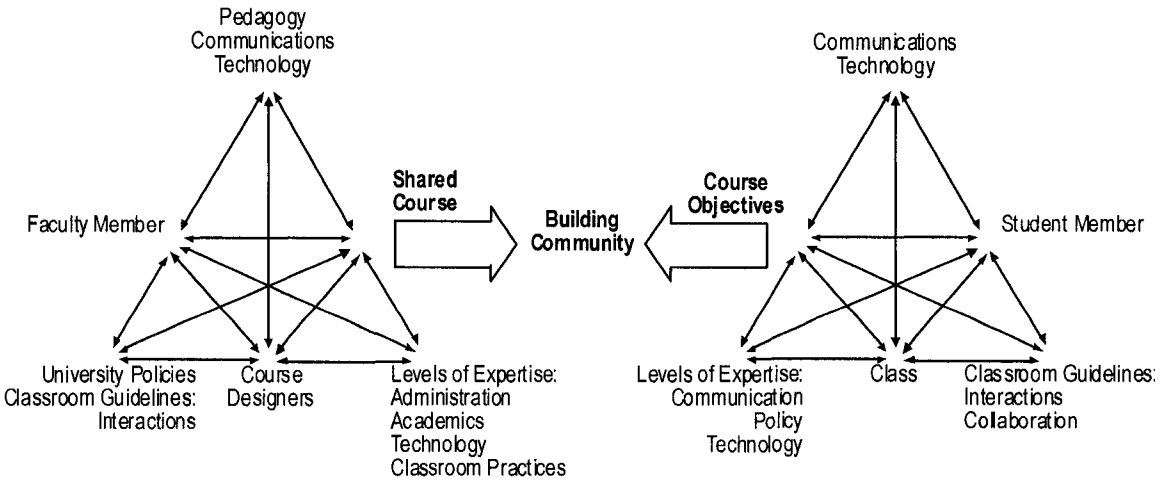
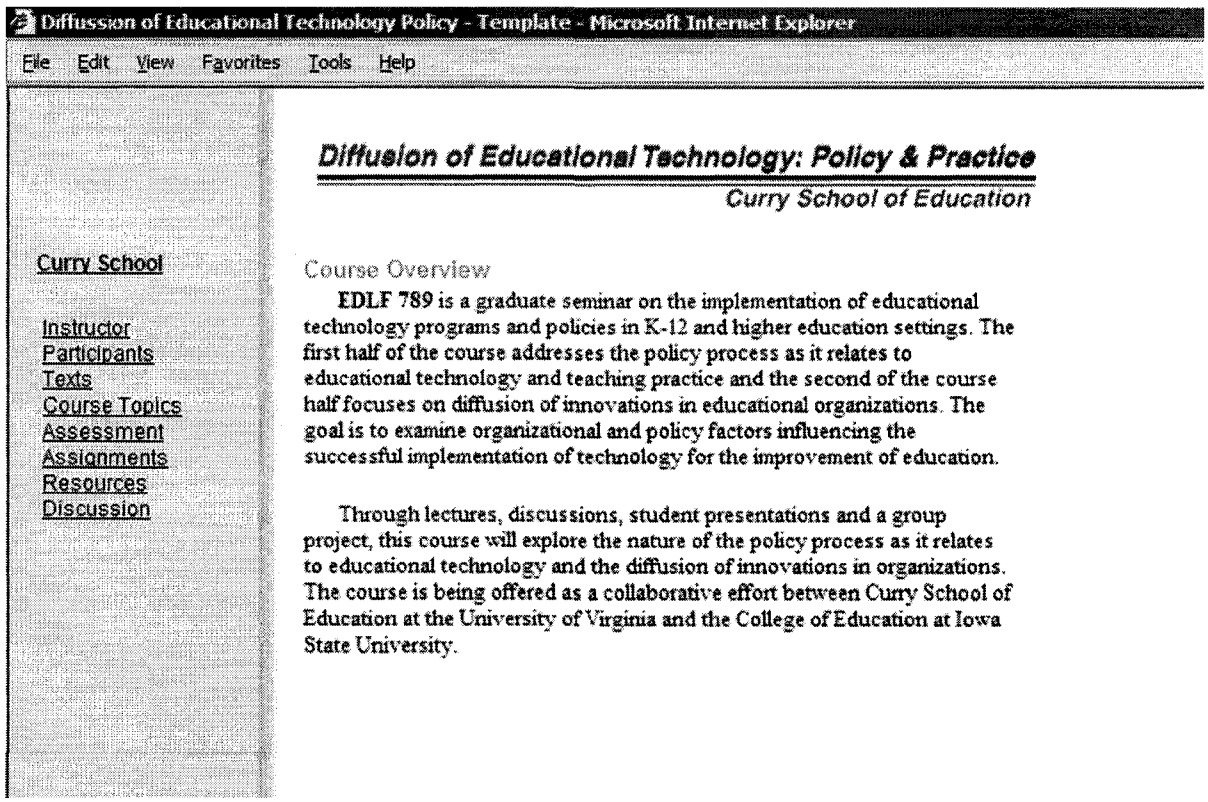


Figure 3. Building community in a shared course.

Appendix B. Course Web Page



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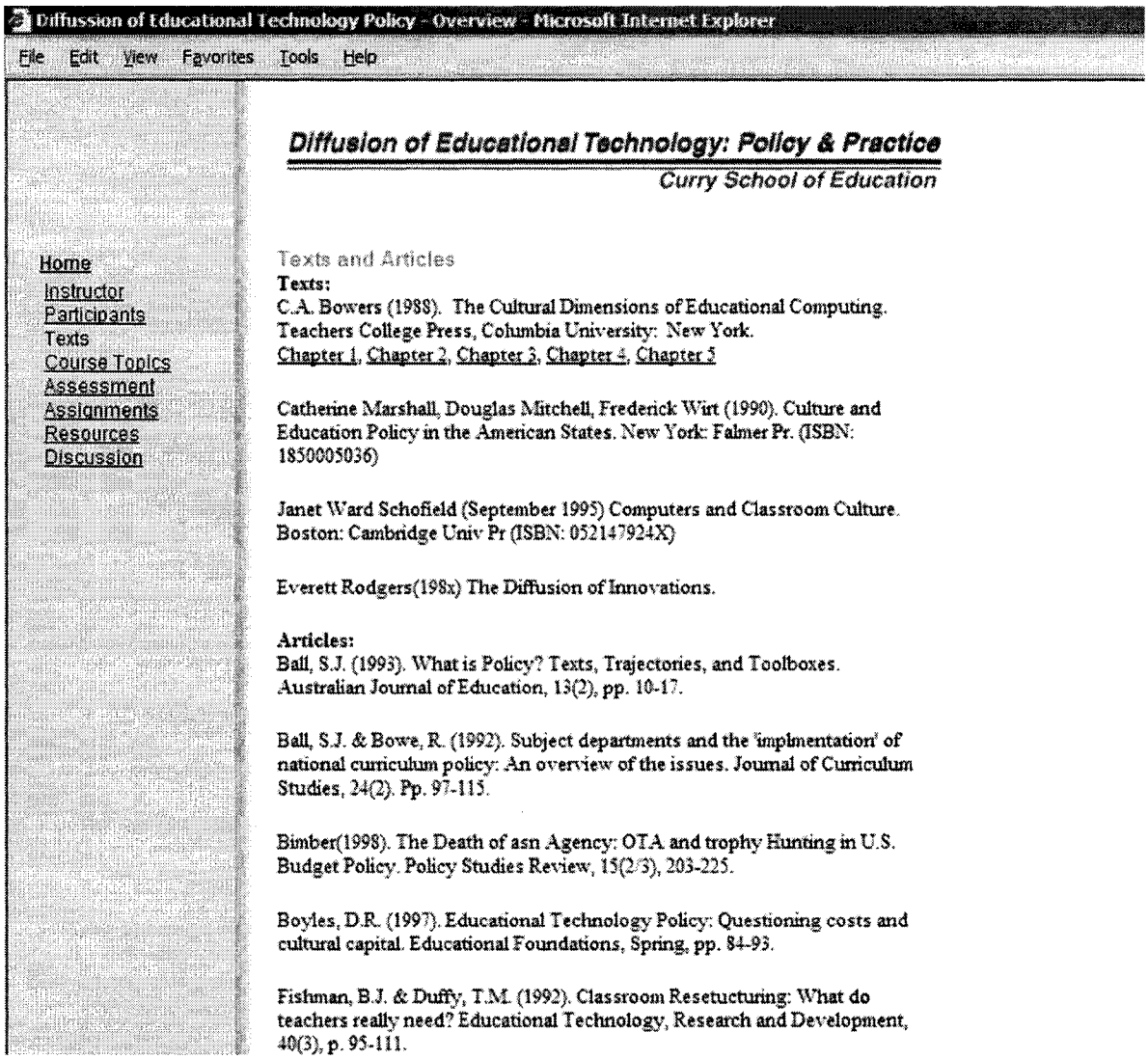

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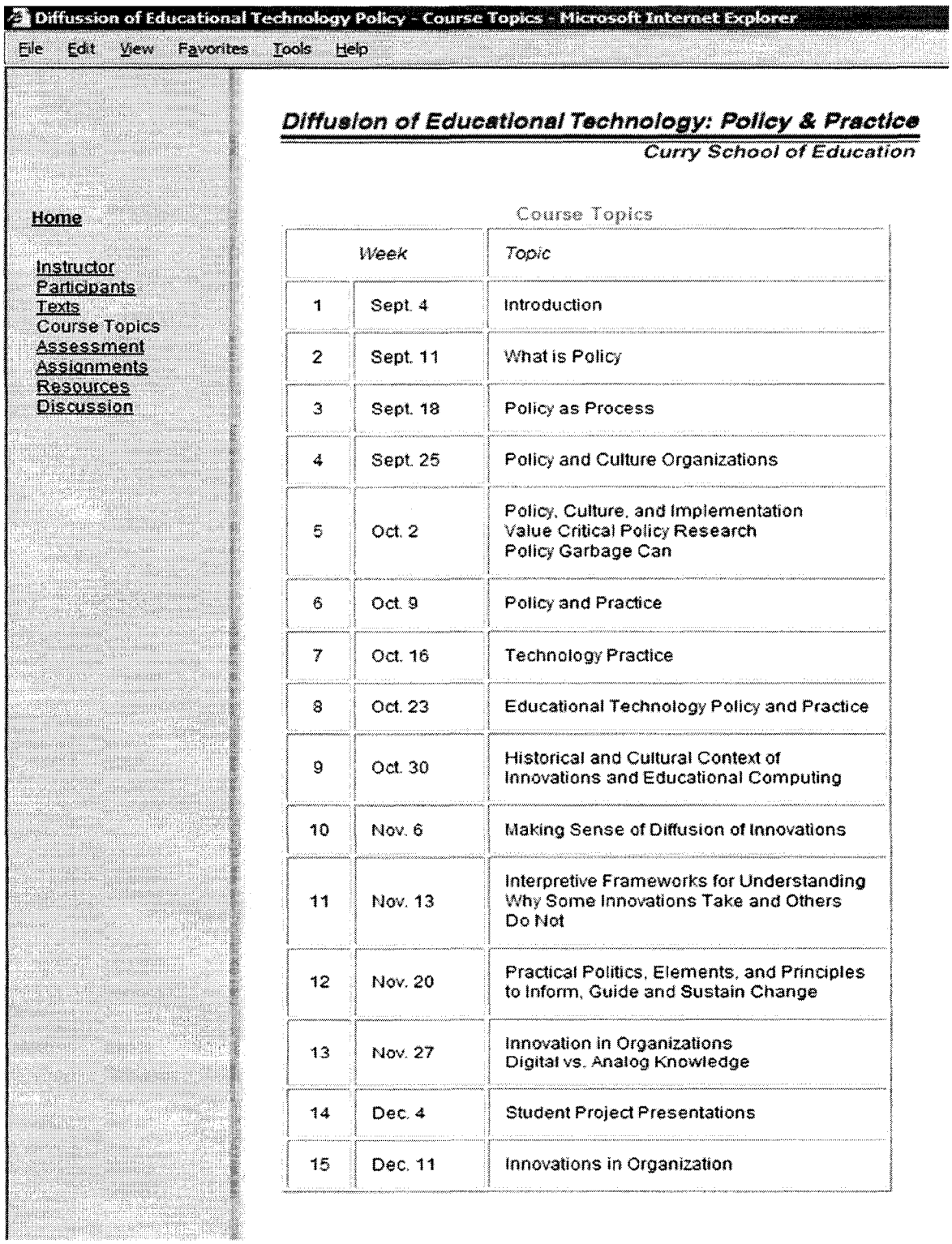
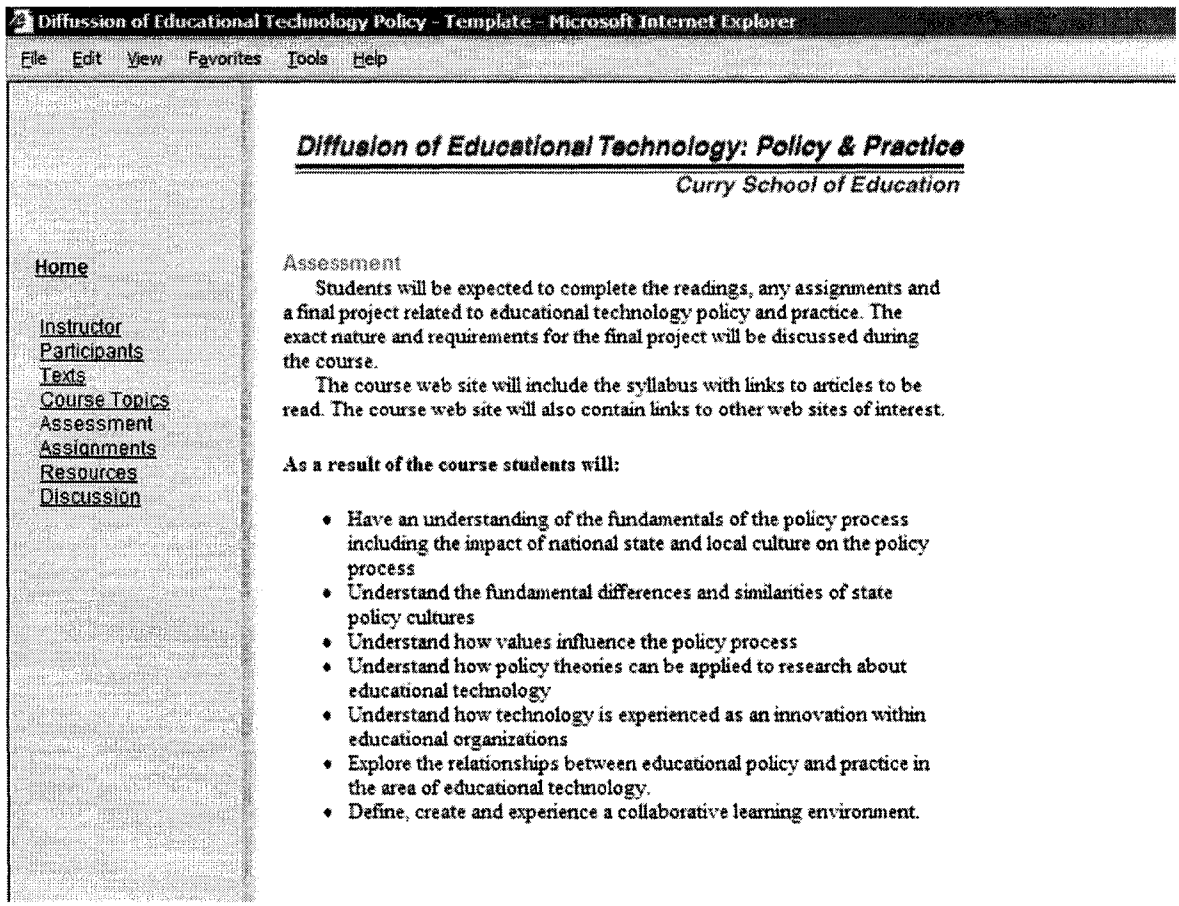
Appendix B. Course Web Page



Week		Topic
1	Sept. 4	Introduction
2	Sept. 11	What is Policy
3	Sept. 18	Policy as Process
4	Sept. 25	Policy and Culture Organizations
5	Oct. 2	Policy, Culture, and Implementation Value Critical Policy Research Policy Garbage Can
6	Oct. 9	Policy and Practice
7	Oct. 16	Technology Practice
8	Oct. 23	Educational Technology Policy and Practice
9	Oct. 30	Historical and Cultural Context of Innovations and Educational Computing
10	Nov. 6	Making Sense of Diffusion of Innovations
11	Nov. 13	Interpretive Frameworks for Understanding Why Some Innovations Take and Others Do Not
12	Nov. 20	Practical Politics, Elements, and Principles to Inform, Guide and Sustain Change
13	Nov. 27	Innovation in Organizations Digital vs. Analog Knowledge
14	Dec. 4	Student Project Presentations
15	Dec. 11	Innovations in Organization

Appendix B. Course Web Page



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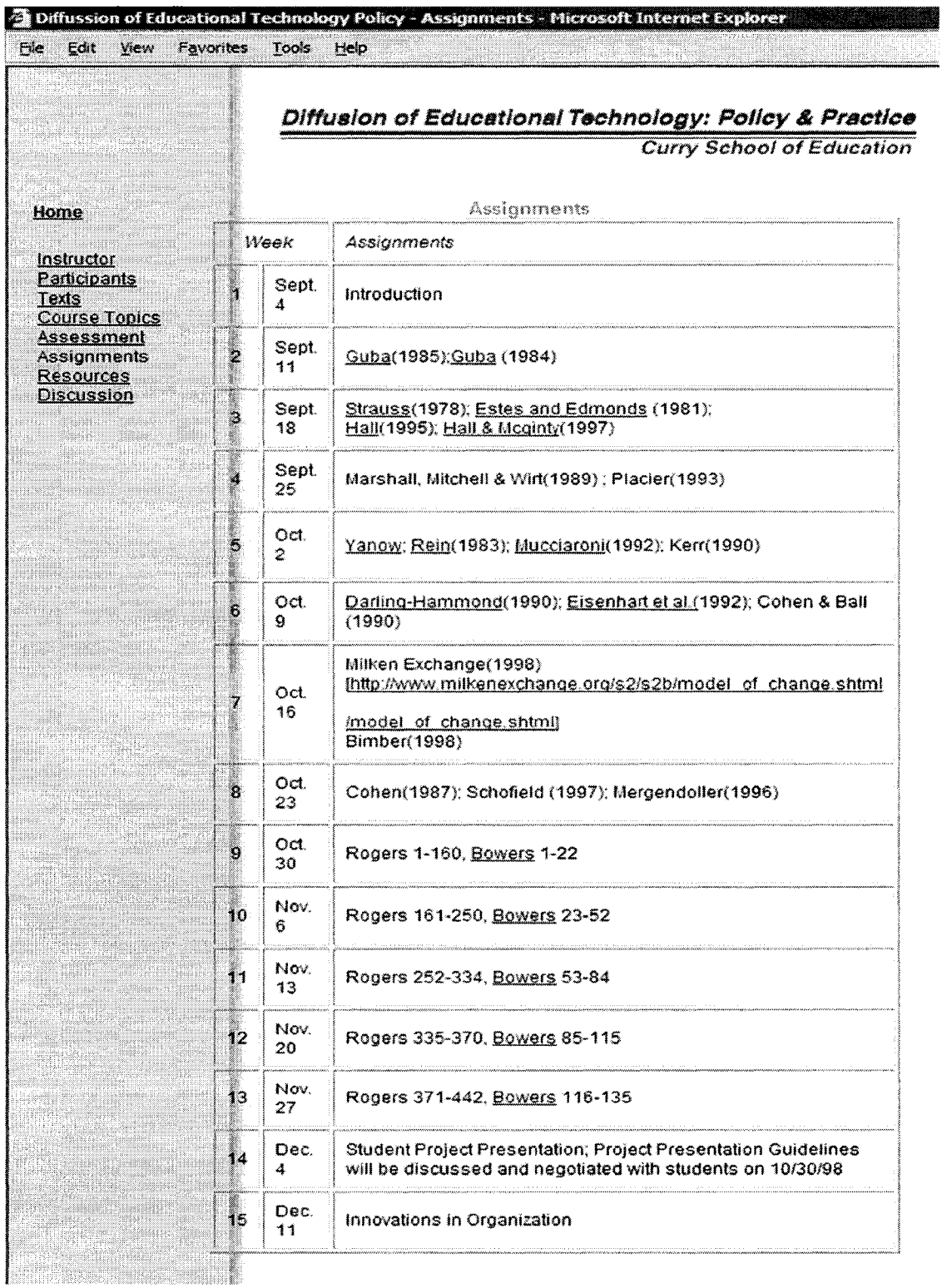

Diffussion of Educational Technology Policy - Assignments - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Diffusion of Educational Technology: Policy & Practice

Curry School of Education

Home

Instructor
Participants
Texts
Course Topics
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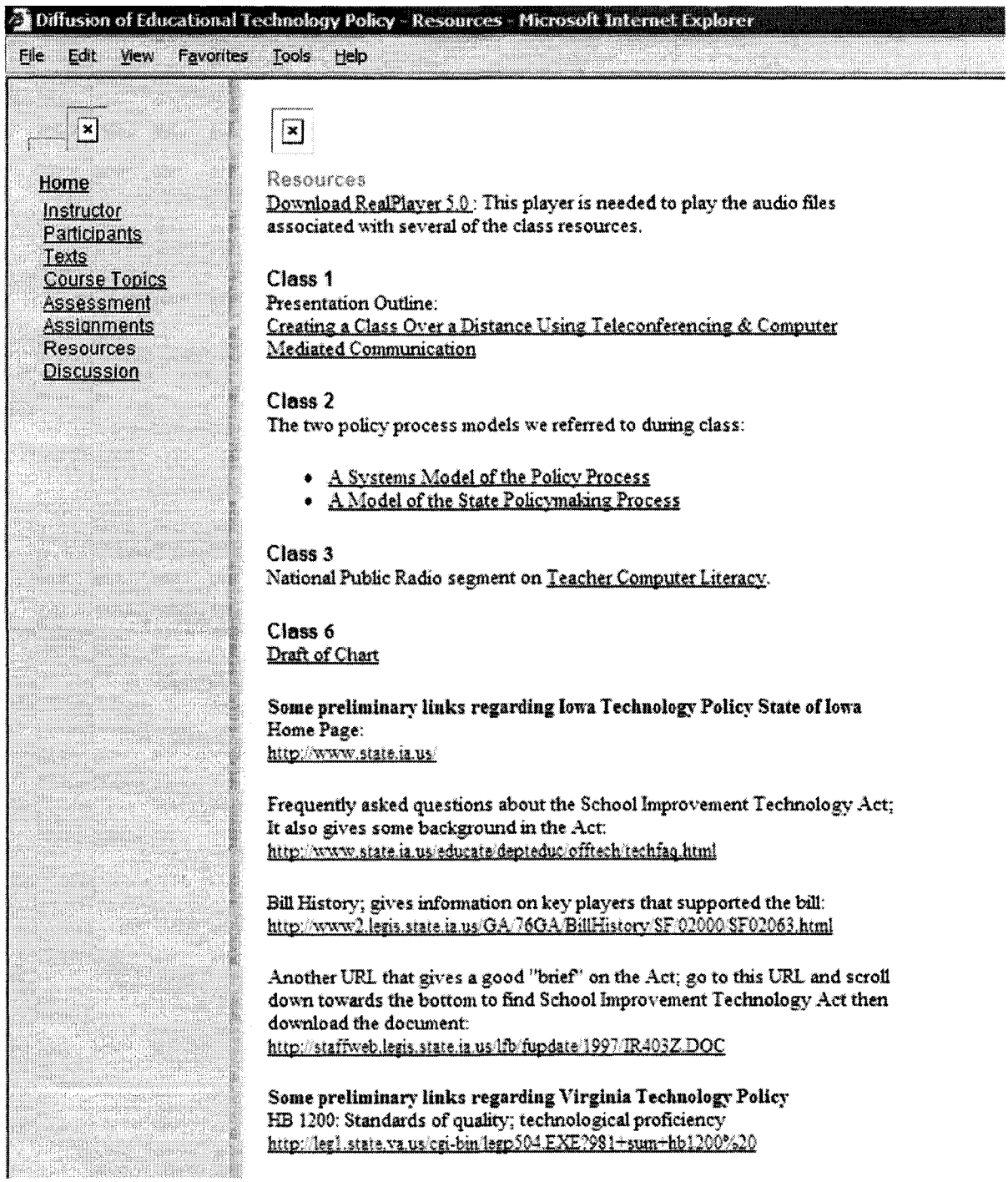
Assignments

	Week	Assignments
1	Sept. 4	Introduction
2	Sept. 11	Guba(1985);Guba (1984)
3	Sept. 18	Strauss(1978); Estes and Edmonds (1981); Hall(1995); Hall & Mcginty(1997)
4	Sept. 25	Marshall, Mitchell & Wirt(1989) ; Placier(1993)
5	Oct. 2	Yanow; Rein(1983); Mucciaroni(1992); Kerr(1990)
6	Oct. 9	Darling-Hammond(1990); Eisenhart et al.(1992); Cohen & Ball (1990)
7	Oct. 16	Milken Exchange(1998) [http://www.milkenexchange.org/s2/s2b/model_of_change.shtml /model_of_change.shtml] Bimber(1998)
8	Oct. 23	Cohen(1987); Schofield (1997); Mergendoller(1996)
9	Oct. 30	Rogers 1-160, Bowers 1-22
10	Nov. 6	Rogers 161-250, Bowers 23-52
11	Nov. 13	Rogers 252-334, Bowers 53-84
12	Nov. 20	Rogers 335-370, Bowers 85-115
13	Nov. 27	Rogers 371-442, Bowers 116-135
14	Dec. 4	Student Project Presentation; Project Presentation Guidelines will be discussed and negotiated with students on 10/30/98
15	Dec. 11	Innovations in Organization

Appendix B. Course Web Page



Appendix B. Course Web Page

Standards of Quality; technological proficiency. Revises the Standards of Quality to direct school divisions to incorporate within their programs of instruction for grades K-12 emphasis on technological proficiency. The Standards of Learning for mathematics, English, science, and history and social science, revised in 1995, include computer and technology standards for skills to be acquired by the end of grades five and eight.

HB 1317: Education; school-based access to information infrastructure
http://leg1.state.va.us/cgi-bin/legp504.EXE?981+sum+hb1317

The bill requires such schools to employ computer hardware or software inhibiting access to materials harmful to juveniles, obscene materials, child pornography and other materials inconsistent with public schools' educational mission.

HJ 176: Study; guidelines for technology connectivity
http://leg1.state.va.us/cgi-bin/legp504.EXE?981+sum+hj176

Guidelines for technology connectivity. Requests the Department of Education to assess the technology needs of local school divisions and to develop guidelines for technology connectivity for the public schools.
http://www.pen.k12.va.us/go/VDOE/Technology/faq.html

The Governor's and General Assembly's Technology Initiative for 1996-98 endorses the recommendations in the Board of Education's Six-Year Technology Plan and supports many of the goals of the school division technology plans through a financing, procurement, instructional support, and training program designed to increase equity and educational opportunity in the Commonwealth's schools.

Training
http://curry.edschool.virginia.edu/class/edlf789ETPolicy/<font%20face="Times%20New%20Roman,%20Times,%20serif">http://leg1.state.va.us/cgi-bin/legp504.exe?981+sum+HB432%20HB%20432%3C/font%3E
Training of teachers, administrators, and superintendents, establishes a number of initiatives supporting professional training and development among public school personnel to implement various recommendations of the Commission on the Future of Public Education (HJR 196 of 1996). This bill also amends the mentor teacher statute to require the Board of Education to establish guidelines for training programs to support the Standards of Learning, including training in English, mathematics, science, technological studies, and history and social sciences to provide support for teachers in public elementary and secondary schools and the development of leadership skills for principals, superintendents, and other administrative personnel.

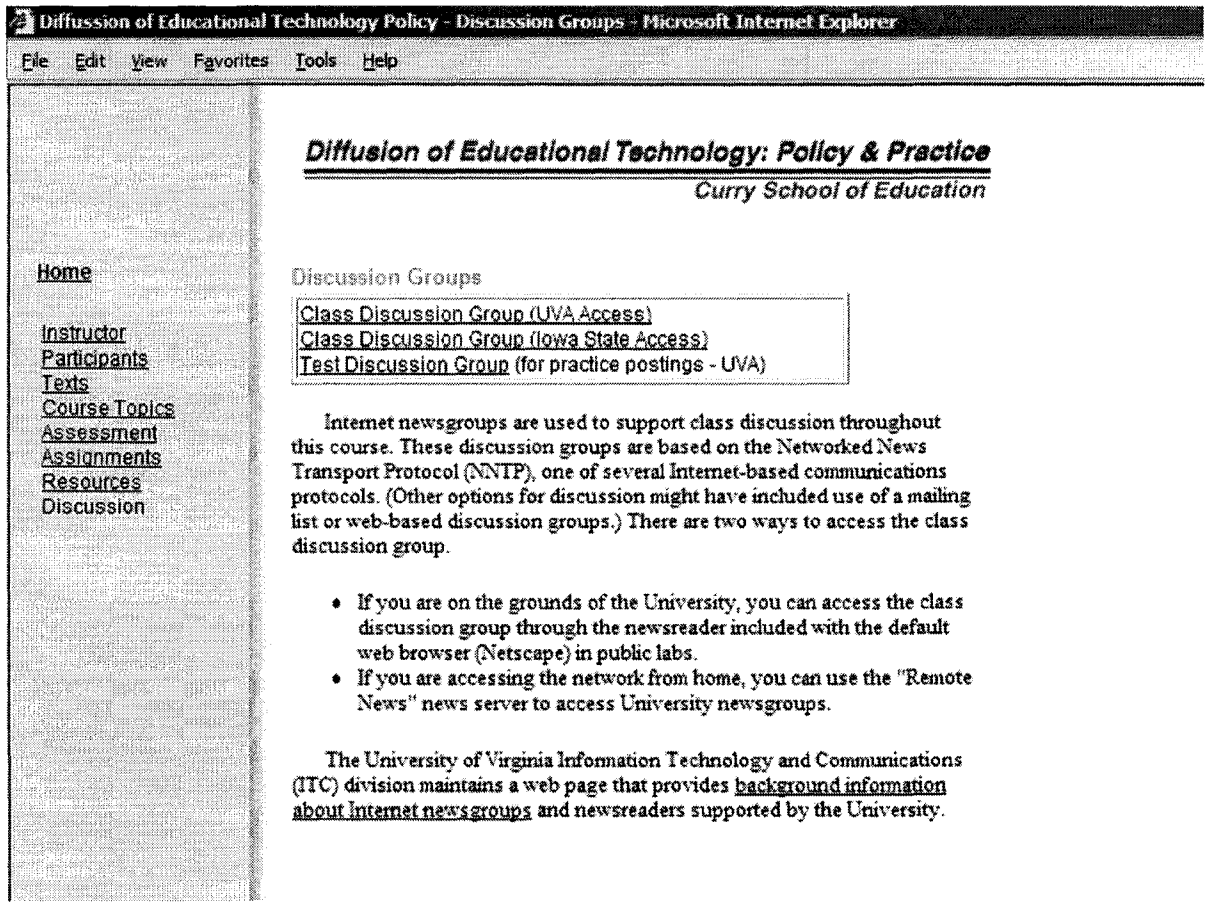
Appendix B. Course Web Page

http://leg1.state.va.us/cgi-bin/legp504.exe?981+sum+SB166%20SB%20166
Training and professional development of teachers, etc.,for the training and professional development of teachers, administrators, and superintendents. Establishes several teacher training and development initiatives, such as (i) requiring the Board of Education to develop leadership standards for superintendents and principals; (ii) requiring compliance with these leadership standards as a condition of licensure for superintendents and principals on and after July 1, 2000; and (iii) conditioning initial licensure for individuals who graduate from Virginia institutions of higher education to endorsement areas offered at institutions that have been assessed by a national accrediting agency or be a state approval process on and after July 2002. Equity/ access

http://leg1.state.va.us/cgi-bin/legp504.exe?981+ful+CHAP0828
CHAPTER 828 relating to programs to promote educational opportunities, finding that educational technology is one of the most important components, along with highly skilled teachers, in ensuring the delivery of quality public school education throughout the Commonwealth. Further, the General Assembly notes that education technology can only be successful if teachers and administrators are provided adequate training and assistance.

http://leg1.state.va.us/cgi-bin/legp504.exe?981+ful+SB399
SENATE BILL NO. 399, relating to programs to promote educational opportunities, finding that educational technology is one of the most important components, along with highly skilled teachers, in ensuring the delivery of quality public school education throughout the Commonwealth.

Appendix B. Course Web Page



Appendix C. Informed Consent Letter

N031 Lagomarcino
Iowa State University
Ames, Iowa 50011
"Date"

Dear "Participant"

I invite you to participate in the study designed to describe the electronic collaborative learning environment that was initiated between University of Virginia and Iowa State University this past fall semester in the sharing of graduate courses: Diffusion of Educational Technology: Policy & Practice and Philosophical Foundations of Instructional Technology. Your participation would entail an one hour interview using video and audio conferencing.

Your participation is voluntary and you may discontinue participation at any time. The data you provide on your perspectives of the electronic collaborative learning environment will be held confidential and will not be shared by the researcher. All data you provide will be reported in groups or using pseudonyms; you will never be identified in any reports produced from this project. Recording devices including video and audio will be used to aid the researcher in notetaking. The tapes will be erased and notes destroyed at the conclusion of the study in May 1999. Only the researcher will have access to the interview notes and transcripts.

If you agree to participate, please fill out the form below.

Sincerely

Rhea R. Walker
Graduate Student

Dr. Ann Thompson
Co-Major Professor

****

I, (please print name) _____ am aware of the purpose and procedures of the Electronic Collaborative Learning study being conducted. I am also aware that my participation in the study is voluntary and the data collected will be held confidential.

_____ _____

Signature Date

Appendix D. Interview Questions

Classroom Climate/Culture

- What are the responsibilities of the teacher within the distance learning framework you have experienced?
- How do you learn best? Was this environment conducive to your learning?
- What are the similarities and differences you found between you and the participants at a distance?
- What is the emerging relationship between the two sites?
- Did you feel a welcomed participant or isolated while taking the distance learning course?
- What components are necessary in developing a class?
- What is your comfort level with technology?

Technology

- How can this technology improve graduate programs at Iowa State University and University of Virginia?
- Did technical problems interfere in your learning?
- What role did technology play in the classroom? in the overall course experience?
- How did technology influence the communications between the two sites?
- If you have participated in or observed traditional distance education, how is this process different or similar?

Consequences

- What implications or issues does this technology bring to education?
- How has this technology changed your definition of what constitutes a classroom?
- What type of class would be best suited for this technology?
- How does this technology best serve the needs of learners? of society?
- What concerns do you have about this technology in changing traditional views of education?

Infrastructure

- How did the physical layout of the classroom affect your learning?
- How were the teaching strategies changed or adapted to the technology?
- How were you motivated to participate in the class?
- What suggestions do you have in making changes in using the technology?
- What type of faculty development have you observed or have participated in with this technology in using the system or adapting teaching strategies to distance learning?

Any Additional Comments

Appendix E. Equipment List

Collaborative Education Lab – Equipment List Center for Technology and Teacher Education				
Component	**Company**	**Model**	**Price***	**Contact**
Equipment Required for Compatibility (vendor specific)				
Electronic Whiteboard	Softboard	201 Wall Mount 54" x 60"	$2,090 $300 Installation	www.softboard.com
Video Conferencing Equipment	VCON	Escort 25 Pro	$800	www.vcon.com
Application Integration	Softblox	SmartPad	$200	www.softblox.com
NetMeeting	Microsoft	Version 2.1	Free Download	www.microsoft.com/netmeeting
Other Equipment (non vendor specific)				
Analog Telephone	Polycom	Soundstation with Wireless Mics	$1,300	www.polycom.com
Projector	InFocus	LP 725	$4,500	www.infocus.com
Optional Equipment				
Wireless Keyboard	Wireless Computing	Wireless Surfboard	$415	www.wireless-computing.com

* Price list based on cost in 1998.